

CDM FEDERAL PROGRAMS CORPORATION

August 28, 1992

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Elizabeth Van Rabenswaay Regional Project Officer U.S. Environmental Protection Agency 26 Federal Plaza New York, New York 10278

PROJECT:

TES V, EPA CONTRACT NO: 68-W9-0002

DOCUMENT NO:

TES5-RO2024-EP-CPMV

SUBJECT:

EPA Work Assignment RO2024

Draft Report Environmental Priority Initiative

Preliminary Assessment

Browning-Ferris Industry, Elizabeth, New Jersey

EPA ID Number: NJD058117979

Document Control No: TES5-RO2024-RT-CPMW

Dear Ms. Van Rabenswaay:

Please find enclosed the draft report entitled, "Environmental Priority Initiative Preliminary Assessment for Browning-Ferris Industry, Elizabeth, New Jersey", as partial fulfillment of the reporting requirements for this work assignment.

If you have any comments regarding this draft submittal, please contact Jeanne Litwin at (212) 393-9634 within two weeks from the date of this letter. CDM Federal will finalize this report following EPA's comments.

Sincerely,

CDM FEDERAL PROGRAMS CORPORATION

Scott B. Graber

TES V Regional Manager

Enclosure

cc: Tim Gordon, EPA Work Assignment Manager, RCRA Region II
Patricia Tom, CDM FEDERAL PROGRAMS CORPORATION
Pam Philip, CDM FEDERAL PROGRAMS CORPORATION
Jeanne Litwin, CDM FEDERAL PROGRAMS CORPORATION
Document Control, CDM FEDERAL PROGRAMS CORPORATION (2 copies)
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DRAFT REPORT

ENVIRONMENTAL PRIORITY INITIATIVE PRELIMINARY ASSESSMENT BROWNING-FERRIS INDUSTRY, ELIZABETH, NEW JERSEY

NJD058117979

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY Office of Waste Programs Enforcement Washington, D.C. 20460

EPA Work Assignment No.

EPA Region

Site No.

Contract No.

CDM FEDERAL PROGRAMS CORPORATION

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: August 28, 1992

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ENVIRONMENTAL PRIORITY INITIATIVE PRELIMINARY ASSESSMENT

PART I: SITE INFORMATION

1.	Site Name	te Name <u>Browning-Ferris Industry of Elizabeth, New Jersey, Inc.</u>		
	Contact Person	Dennis Galbraith		
	Street	714 Division Street		
	City	Elizabeth State NJ Zip 07207		
2.	County	Union		
3.	EPA ID No.	NJD058117979		
4.	Latitude	40° 40' 26" Longitude 74° 11' 28"		
	USGS Quad.	Elizabeth		
5.	Owner	F.J. & R.E. Gentempo Tel. No. (908) 352-2222		
	Street	P.O. Box 508		
	City	Elizabeth State NJ Zip 07207		
6.	Operator	Browning-Ferris Industry of Elizabeth, New Jersey, Inc. Tel. No. (908) 352-2222		
	Street	714 Division Street		
	City	Elizabeth State NJ Zip 07207		
7.	Type of Ownership			
	X Private	Federal State		
	County	Municipal Unknown Other		
8.	Owner/Operato	r Notification on File		
	X RCRA 3001 Date 8/20/80 CERCLA 103c Date//			
	None	Unknown		

PART I: SITE INFORMATION (continued)

9. Permit Information

Permit No. Date Issued Expiration Date Comments

None

10. Site Status

X Active Inactive Unknown

- 11. Years of Operation 1/15/74 to present
- 12. Identify all solid waste management units (SWMUs)* (e.g., landfill, surface impoundment, piles, stained soil, above or below ground tanks or containers, land treatment, etc.) on site. Use additional pages, as necessary.
 - (a) Solid Waste Management Units
 - 1. Former (Solid and Hazardous Waste) Transfer Station
 - (b) Other Areas of Concern (AOC)

Identify any miscellaneous spills, non-hazardous dumping, etc. on sites; describe the materials and identify their locations on site.

A. Underground Gasoline Storage Tank

This carbon steel, 12,000 gallon capacity tank is located adjacent to the Division Street entrance of the facility. It was installed sometime in the 1950's and is currently used for the storage of gasoline.

B. Used Oil Storage Area

Used oil from maintenance operations is stored in the Maintenance Building awaiting disposal pickup by Safety Kleen.

13. Date of visual site inspection $\frac{6/26/92}{}$

Inspectors present Name Robert Pedneault Firm CDM FEDERAL PROGRAMS CORPORATION

Name <u>Patricia Tom</u> Firm <u>CDM FEDERAL PROGRAMS CORPORATION</u>

^{*}Any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely or systematically released.

SITE SUMMARY

Browning-Ferris Industries (BFI) has been operating at 714 Division Street in Elizabeth, New Jersey since 1974. Prior to 1974, the property was owned by the City of Elizabeth.

BFI initially used the property as a transfer station for hazardous waste collected from local industry. Bulk and drummed solid and semi-solid industrial hazardous waste was collected by BFI and transported to the Elizabeth facility. At the facility it was segregated and stored until it could be transported to a permitted disposal facility. BFI ceased hazardous waste operations at this location in November 1982 and was delisted as a hazardous waste facility by the New Jersey Department of Environmental Protection and Energy in December 1983.

The facility was then used as a transfer station for non-hazardous solid and semi-solid waste. Non-hazardous industrial waste was collected by BFI and transported to the Elizabeth facility. The waste was then stored at the facility until it could be transported to a permitted disposal facility. BFI ceased solid waste operations at the facility in 1989.

The property is currently used by BFI as a parking area for waste disposal vehicles and empty trash receptacle

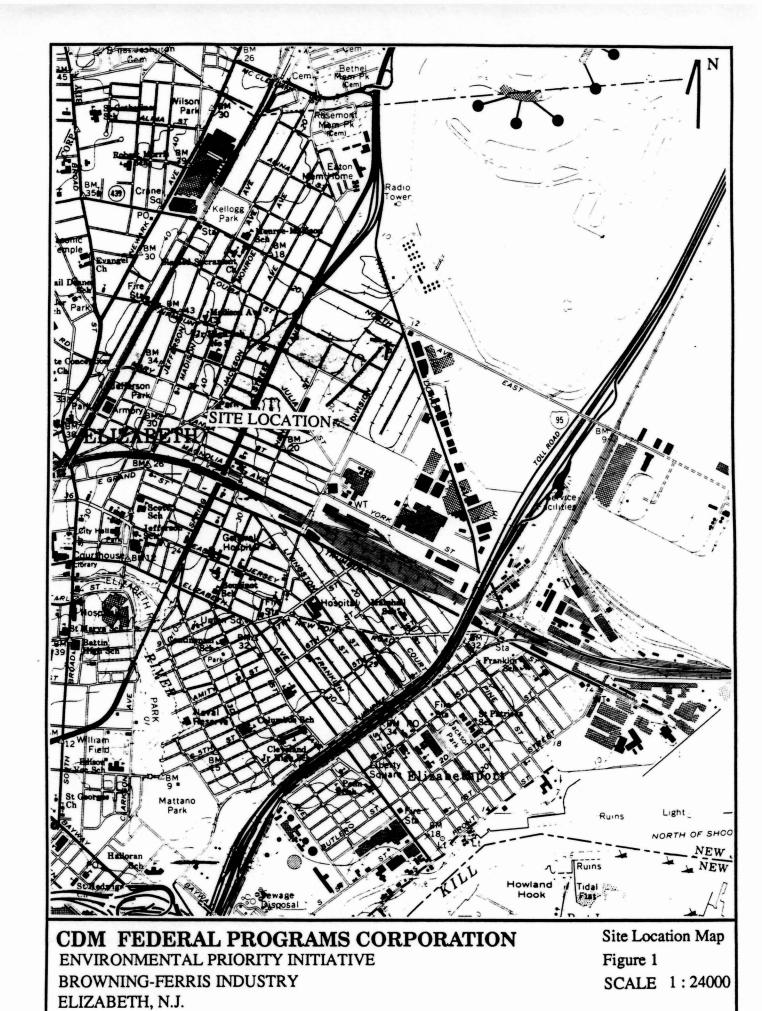
Ref. No.: 2,3,4,11,13,14

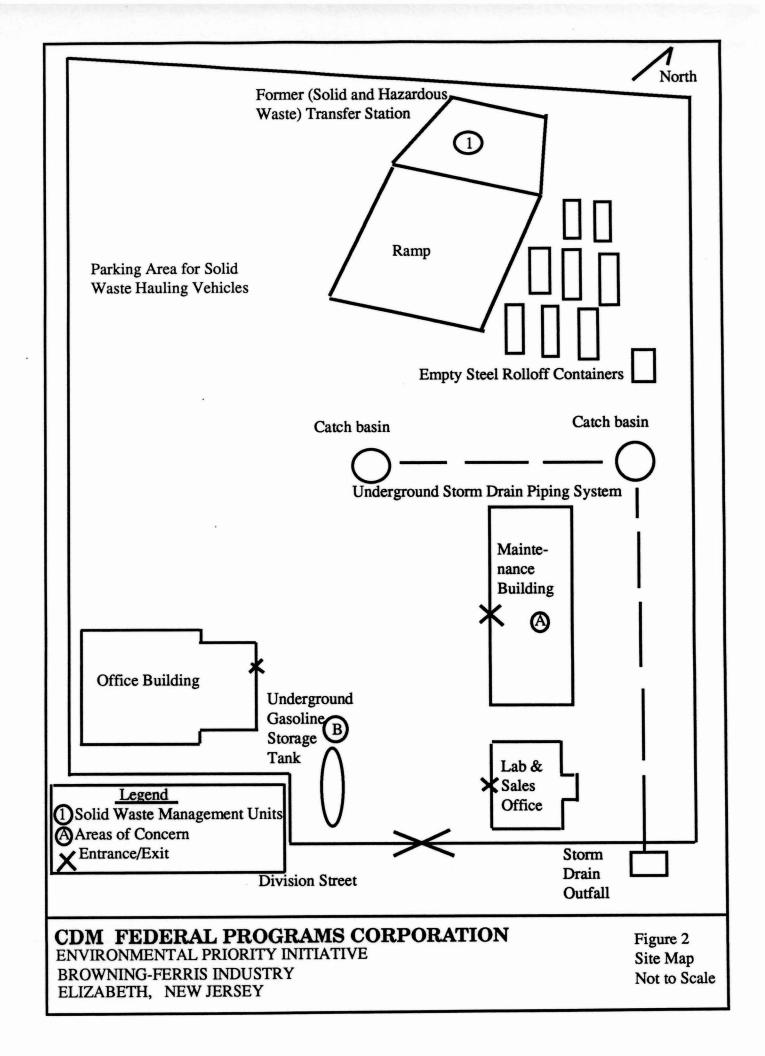
Table 1 Solid Waste Management Units (SWMUs) and Areas of Concern AOC

Browning-Ferris Industry Elizabeth, New Jersey

Solid Waste Management Units (SWMUs)

- 1) Former (Solid and Hazardous Waste) Transfer Station
 - Other Areas of Concern (AOC)
- A) Used Oil Storage Area
- B) Underground Gasoline Storage Tank





PART II: HAZARDOUS WASTE MANAGED/EVIDENCE OF RELEASE

Complete the information listed below for all SWMUs identified in Part I.

SWMU No. 1 FORMER (SOLID AND HAZARDOUS WASTES) TRANSFER UNIT

1. Describe the location of the SWMU and identify clearly on the site map.

The former transfer unit is located to the rear of the facility by the northwest property line.

Ref. No.: 2

2. Describe the physical characteristics of the SWMU. Document method of containment. Include the following: size of unit; age; release controls; start-up and closure dates.

The former transfer unit was concrete lined, roofed, and elevated on a concrete platform which was situated on paved ground. It was used in the transfer of solid and semisolid industrial hazardous waste. The waste was transferred from the transporter vehicles to steel rolloff containers via a rampway that led to the concrete lined pit. The pit had awaiting steel rolloff containers. It was then transported to a Treatment Storage Disposal Facility (TSDF). The transfer unit was in operation from 1974 until it closed in 1983 with approval from the New Jersey Department of Environmental Protection and Energy's (NJDEPE) Bureau of Hazard Waste Engineering. The hazardous waste transfer station was then converted to a solid waste transfer station. Industrial waste was transferred from the transporter vehicles to steel rolloff boxcar containers and then carted off to a final disposal facility. All transfer operations ceased in June 1989. The station's ramp leveled areas are currently used for the temporary storage of steel waste receptacles.

Ref. No.: 2,4,11,13,14

3. Identify hazardous constituents which may be present in the SWMU (include RCRA waste code). Include all wastes originally or currently contained in the SWMU. Identify the physical state(s) of the constituents as disposed of in the unit (solid, powder or fines, sludge, slurry, liquid, or gas). Identify quantity of waste, if known.

This unit has been inactive since solid waste operations ceased in 1989. From 1974 to 1983 the unit operated as a hazardous waste transfer unit. RCRA solid and liquid hazardous waste was handled by the unit. Ref. No.: 2,28

4. Discuss any evidence of a release of hazardous constituents. Include the following: history of release (documented in RCRA enforcement or permitting documents; facility records; or other federal, state or local agency documents); visual evidence (odor, stained soil or leaks); or sampling data.

There have been no documented releases of hazardous constituents related to this unit.

Ref. No.: 2,5,7

PART II: HAZARDOUS WASTE MANAGED/EVIDENCE OF RELEASE (continued)

5. Describe the likelihood or evidence of a release of hazardous constituent(s) to the groundwater as follows: observed release, suspected release, or none. Identify hazardous constituent(s), detected or suspected and provide a rationale for attributing them to the SWMU. For observed release, define the supporting analytical evidence.

There have been no documented releases of hazardous constituents to the groundwater related to this unit. The likelihood of a release to the groundwater is limited as the concrete lining around the steel rolloff boxcar containers in the pit would have contained any spills or leaks during the waste transfer operations.

Ref. No.: 2

6. Describe the likelihood or evidence of a release of hazardous constituent(s) to surface water as follows: observed release, suspected release, or none. Identify hazardous constituent(s) detected or suspected and provide a rationale for attributing them to the SWMU. For observed release, define the supporting analytical evidence.

There have been no documented releases of hazardous constituents to the surface water related to this unit. The likelihood of a release to surface water is limited as the concrete lining around the steel rolloff boxcar containers would contain any spills or leaks during the waste transfer operations.

Ref. No.: 2,5,7

7. Describe the likelihood or evidence of a release of hazardous constituent(s) to soil as follows: observed release, suspected release, or none. Identify hazardous constituent(s) detected or suspected and provide a rationale for attributing them to the SWMU. For observed release, define the supporting analytical evidence.

There have been no documented releases of hazardous constituents to soil related to this unit. The likelihood of a release to soil is limited as the concrete lining around the steel rolloff boxcar containers would contain any spills or leaks during the waste transfer operations.

Ref. No.: 2

8. Describe the likelihood or evidence of a release of hazardous constituent(s) to the air as follows: observed release, suspected release or none. Identify the hazardous constituent(s) detected or suspected, and provide a rationale, for attributing them to the SWMU.

There have been no documented releases of hazardous constituents to the air related to this unit.

Ref. No.: 2

PART III: POTENTIAL RECEPTORS

1. Describe the aquifer of concern, include information such as depth, thickness, geologic composition, areas of karst terrain, permeability, overlying strata, confining layers, interconnections, discontinuities, depth to water table, groundwater flow direction.

The aquifer of concern lies in the Brunswick Formation. The Brunswick Formation is the youngest, thickest, and most extensive unit of the Newark Group of the Late Triassic age. Virtually all ground water in this aquifer occurs in interconnecting fractures that have resulted from jointing. The formation has practically no effective primary porosity. It has a thickness of more than 10,000 feet and consists of non-marine reddish-brown mudstone, shale, siltstone, and sandstone interbedded with conglomeratic sandstones along basin margins. Groundwater in the Brunswick appears to flow primarily by partings along bedding and occurs under both water table and confined conditions. Depth to groundwater ranges from 10 to 16 feet below ground surface in wells located in Elizabeth near the site. Although no information is available as to groundwater flow at the site, it likely flows toward the Elizabeth River to the southwest.

Ref. No.: 19,23,24,25,27

2. Is a designated sole source aquifer within 3 miles of the site?

A designated sole source aquifer is not within 3 miles of this site.

Ref. No.: 26,32

3. What is the depth from the lowest point of waste disposal/storage to the highest seasonal level of the saturated zone of the aquifer of concern?

The former transfer pit area would have been representative of the lowest point of the waste disposal/storage area. The aquifer of concern at its highest seasonal level is 10 to 16 feet below the lowest point in the former transfer pit area.

Ref. No.: 2,22

4. What is the permeability value of the least permeable continuous intervening stratum between the ground surface and the aquifer of concern?

The least permeable continuous intervening stratum between the ground surface and the aquifer of concern consist mainly of clay, red shale and gravel has an intrinsic permeability value ranging between 10⁻²-1 Darcys and has a hydraulic conductivity ranging between 10⁻⁵-10⁻³(cm/sec).

Ref. No.: 1

5. What is the net precipitation for the area?

Net precipitation for the area is approximately 20 inches.

Ref. No.: 16,18

6. Identify uses of ground water within 3 miles of the site (i.e., private drinking source, municipal source, commercial, industrial, irrigation, unusable).

Wells within 3 miles of the site are primarily used for industrial purposes. Well records indicate that the ground water is also used for commercial and domestic purposes.

Ref. No.: 19

7. What is the distance to and depth of the nearest well that is currently used for drinking or irrigation purposes?

A domestic well is located two miles away. It is unknown whether this well is currently used for drinking.

Ref. No.: 19,33

8. Identify the population served by the aquifer of concern within a 3 mile radius of the site.

The population within a 3 mile radius of the facility is not served by the aquifer of concern. The population of Elizabeth, New Jersey, approximately 110,000 people, obtains its water from reservoirs by the City of Elizabeth Water & Sewer Utility. The utility company obtains its water from surface water reservoirs.

Ref. No.: 29

SURFACE WATER ROUTE

9. Is the facility in a 100-year floodplain?

The facility is not located on a 100-year floodplain.

Ref. No.: 21

 Identify the nearest downslope surface water. If possible, include a description of possible surface drainage patterns from the site.

The nearest downslope surface water is Woodruffs Creek, which is a tributary of the Elizabeth River.

Ref. No.: 8,12

11. What is the distance in feet to the nearest downslope surface water? Measure the distance along a course that runoff can be expected to follow.

The distance to the nearest downslope surface water, Woodruffs Creek, is approximately 2300 feet. The Elizabeth River is approximately three miles from the site.

Ref. No.: 8,12

12. What is the facility slope in percent? (Facility slope is measured from the highest point of deposited hazardous waste to the most downhill point of the waste area or to where contamination is detected.)

There is no deposited hazardous waste on site.

Ref. No.: 2

13. What is the slope of the intervening terrain in percent? (Intervening terrain slope is measured from the most downhill point of the waste area to the probable point of entry to surface water).

There is no waste area on site.

Ref. No.: 2

14. What is the 1-year 24-hour rainfall?

The 1-year 24-hour rainfall is approximately 2.75 inches.

Ref. No.: 16

15. Identify uses of surface waters within 3 miles downstream of the site (i.e., drinking, irrigation, recreation, commercial, industrial, not used).

Woodruffs Creek flows into the Elizabeth River, which is located within 3 miles downstream of the site. The Elizabeth River is used for secondary contact recreation, maintenance and migration of fish populations and wildlife.

Ref. No.: 6,8,9,12

16. Describe any wetlands, greater than 2 acres in area, within 2 miles downstream of the site. Include whether it is a freshwater or coastal wetland.

There are no wetlands greater than two acres in area within two miles downstream of the site.

Ref. No.: 9,17

17. Describe any critical habitats of federally listed endangered species within 2 miles of the site along the migration path.

No critical habitats of federally listed endangered species are within 2 miles of the site.

Ref. No.: 31

18. What is the distance to the nearest sensitive environment along or contiguous to the migration path (if any exist within 2 miles)?

No sensitive environment exist within 2 miles.

Ref. No.: 31

19. Identify the population served or acres of food crops irrigated by surface water intakes within 3 miles downstream of the site and the distance to the intake(s).

The population of Elizabeth, New Jersey, approximately 110,000 people, is served by the City of Elizabeth Water and Sewer Utility, Elizabeth Town Water Company and City of Newark Water Company. These companies obtain their water supply from reservoir sources further than 3 miles from the site. There are no surface water intakes within 3 miles downstream of the site that serves a population or irrigates acres of food crops.

Ref. No.: 20,29,33

20. What is the state water quality classification of the water body of concern?

The water body of concern is the Elizabeth River. The New Jersey State Water Quality Classification for the Elizabeth River is SE3. SE3 waters are used for secondary contact recreation; maintenance and migration of fish population; migration of diadromous fish; maintenance of wildlife; and any other reasonable uses.

Ref. No.: 6

21. Describe any apparent biota contamination that is attributable to the site.

There was no apparent biota contamination at the time of the CDM Federal site inspection.

Ref. No.: 2

AIR ROUTE

22. Are there residences located within four miles of the site? Identify the distance to nearest resident.

Yes, the nearest resident to the site is located less than 1000 feet away to the south.

Ref. No.: 2

23. Are there industries located within four miles of the site?

Yes.

Ref. No.: 2

24. Are agricultural lands located within four miles of the site?

No.

Ref. No.: 2

25. What is the distance to sensitive environment(s) (miles).

The distance to bays and estuaries of the Arthur Kill is approximately two and one half miles from the facility.

Ref. No.: 9

LIST OF REFERENCES

- 1) Fetter, C.W., Applied Hydrogeology, Merrill Publishing Company, 1988.
- 2) Field notes as recorded by Patricia Tom of CDM/FEDERAL PROGRAMS CORPORATION (CDM/Federal) taken during facility site inspection on 6/26/92.
- 3) Letter from Frank Coolick, Chief/Bureau of Hazardous Waste Engineering, State of New Jersey Department of Environmental Protection to Peter A. Leonardis, District Manager/Browning-Ferris Industries Elizabeth, NJ District dated 12/12/83.
- 4) Letter from Edward J. Londares, Assistant Director, Engineer/State of New Jersey Department of Environmental Protection to Peter A. Leonardis, District Manager/ BFI Elizabeth, NJ District dated 12/3/83.
- 5) Analytical Report from Daniel W. Heintz, Senior Chemist/Browning-Ferris Industries Houston Laboratory to Mr. Jim Goodkin/BFI of NJ, Inc.dated 11/24/80.
- 6) Surface Water Quality Standard N.J.A.C. 7:9-4.1 et seq., New Jersey Department of Environmental Protection Division of Water Resources, August 1989.
- 7) Analytical Report from Garry J. Gilbert/Townley Research and consulting, Inc. to Mr. Jim Goodkin/BFI of NJ, Inc. dated 11/12/80.
- 8) Water Basin Overlay Map, Bureau of Geology and Topography, State of New Jersey DEPE.
- 9) Land Usage Overlay Map, Bureau of Geology and Topography, State of New Jersey DEPE.
- 10) 1987 New Jersey Water Withdrawal Report, New Jersey Department of Environmental Protection, Division of Water Resources, Bureau of Water Allocation, 1987.
- 11) Letter from Peter A. Leonardis, District Manager/BFI Elizabeth, NJ District to Thomas Kearns, Chief/Bureau of Registration and Permits Administration, New Jersey Department of Environmental Protection, Division of Solid Waste Management dated 10/10/89.
- 12) Topographic map, Department of Conservation and Economic Development Division of Planning and Development, State of New Jersey DEPE.
- 13) Letter from John Castner, PE Chief Engineer/Engineering Element, State of New Jersey Department of Environmental Protection, Division of Solid Waste Management to Mr. Arthur R. Kobin, Esq. dated 6/20/89.
- 14) Letter from Peter A. Leonardis, District Manager/BFI Elizabeth NJ District to Thomas Kearns, Chief/Bureau of Registration and Permits Administration, New Jersey Department of Environmental Protection, Division of Solid Waste Management dated 10/10/89.
- 15) Letter from Jane M. Puzo, Office Manager, Townley Laboratories, Inc. Environmental Testing Services to Dennis Galbraith/District Manager/BFI Elizabeth, NJ dated 1/10/92.
- 16) The National Atlas of the United States of America, U.S. Department of the Interior Geological Survey, 1970.

- Priority Wetlands List for the State of New Jersey, Prepared by the U.S. Environmental Protection Agency Region II.
- Water Atlas of the United of the United States, Geraghty, Miller, Van Der Leeden, and Troise, Water Information Center, 1973.
- 19) Well Records, New Jersey Department of Conservation and Economic Development, Division of Water Policy & Supply.
- 20) Record of Communication: Conversation between Ms. Joan Moran of City of Elizabeth City Hall and Patricia Tom of CDM/Federal, 5/29/92.
- 21) Letter from Mr. Ernesto J. Marticorena, PE City Engineer of the City of Elizabeth, New Jersey/Department of Public Works, Office of the City Engineer to Patricia Tom of CDM/Federal, received 6/3/92.
- 22) Charts and Tables of Ground Water Levels in Union County.
- Vecchioli, John, Directional Hydraulic Behavior of A Fractured-Shale Aquifer in New Jersey, U.S. Geological Survey Abstract.
- Geology and Ground-Water Resources of Union County, New Jersey, U.S. Geological Survey Water-Resources Investigations 76-73 New Jersey Department of Environmental Protection, Division of Water Resources.
- 25) Michalski, Andrew, Hydrogeology of the Brunswick (Passaic) Formation and Implications for Ground Water Monitoring Practice, Ground Water Monitoring Review, Fall 1990.
- 26) Carter, Gail P., Sole Source Aquifer Petition Approved, Water Resource News, New Jersey Department of Environmental Protection, Division of Water Resources, Volume 4, Number 4, Fall 1988.
- Vecchioli, John, Carswell, Louis D., Kasabach, Haig F., Occurrence and Movement of Ground water in the Brunswick Shale at a Site Near Trenton, New Jersey, 1969.
- .28) U.S. Environmental Protection Agency Notification of Hazardous Waste Activity for BFI Elizabeth, NJ.
- 29) Record of Communication: Conversation between Nancy Coyle, City Engineer/City of Elizabeth and Patricia Tom of CDM/Federal, 7/27/92.
- 30) Record of Communication: Conversation between Regina Vicsik, Site Administrator/BFI Elizabeth, NJ and Patricia Tom of CDM/Federal, 7/28/92.
- 31) Letter from United States Department of the Interior Fish and Wildlife Service to Patricia Tom of CDM/Federal, received 7/27/92.
- Record of Communication: Conversation between Dore Laposta, Water Management Division/EPA Region II, and Patricia Tom of CDM/Federal, 8/18/92.
- 33) Record of Communication: Conversation between Edward Bilazski, Billing and Collection Supervisor/Elizabeth City Hall, and Patricia Tom of CDM/Federal, 8/19/92.

ATTACHMENT 1

Browning-Ferris Industry Elizabeth, New Jersey

Photograph Log

Date:

June 26, 1992

Photographer: Patricia Tom 35mm Camera 100 ASA film

Photo i	#	Time	Description	
	1	10:27	Closed (Solid and Hazardous Waste) Transfer Station looking northwest	
	2	10:30	Closed (Solid and Hazardous Waste) Transfer Station looking southwest	
	3	10:31	Closed (Solid and Hazardous Waste) Transfer Station Trailer Pit looking north	
	4	10:33	Empty rolloff containers	
	5	10:33	Empty trash compactor and catch basin Gas pump that draws from Underground Storage Tank	
	6	10:33		
	7	10:35	Another gas pump that also draws from the Underground Storage Tank	
	8	10:38	Welding shop repair building	
	9	10:38	Empty solid waste disposal hauling vehicle parking area	
	10	11:55	View of facility looking northwest	
	11	11:11	View of Division Street looking out from facility	

ATTACHMENT 2



Photo 1:

Closed (Solid and Hazardous Waste) Transfer Station looking northwest.



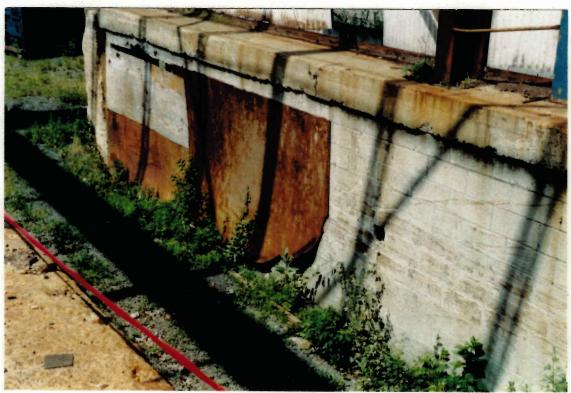


Photo 2:

Closed (Solid and Hazardous Waste) Transfer Station looking southwest.

Time: 10:30

CDM FEDERAL PROGRAMS CORPORATION ENVIRONMENTAL PRIORITIES INITIATIVE BROWNING - FERRIS INDUSTRIES ELIZABETH, NEW JERSEY

Photograph Log



Photo 3:

Closed (Solid and Hazardous Waste) Transfer Station Trailer Pit looking north.





Photo 4:

Empty 200 cubic yard rolloff containers used for solid waste transport.

Time: 10:33

CDM FEDERAL PROGRAMS CORPORATION ENVIRONMENTAL PRIORITIES INITIATIVE BROWNING - FERRIS INDUSTRIES ELIZABETH, NEW JERSEY

Photograph Log



Photo 5:

Empty trash compactor adjacent to catch basin.

Time: 10:33



Photo 6:

Gas pump that draws from the underground storage gas tank with 12,000 gal capacity.

CDM FEDERAL PROGRAMS CORPORATION ENVIRONMENTAL PRIORITIES INITIATIVE BROWNING - FERRIS INDUSTRIES ELIZABETH, NEW JERSEY

Photograph Log
June 26, 1992

Time: 10:33



Photo 7: Another gas pump also drawing from the underground storage tank with 12,000 gal capacity.

Time: 10:35



Photo 8:

Welding shop repair building where used oil is stored for disposal pickup

by Safety Kleen.

Time: 10:38

CDM FEDERAL PROGRAMS CORPORATION ENVIRONMENTAL PRIORITIES INITIATIVE BROWNING - FERRIS INDUSTRIES ELIZABETH, NEW JERSEY

Photograph Log

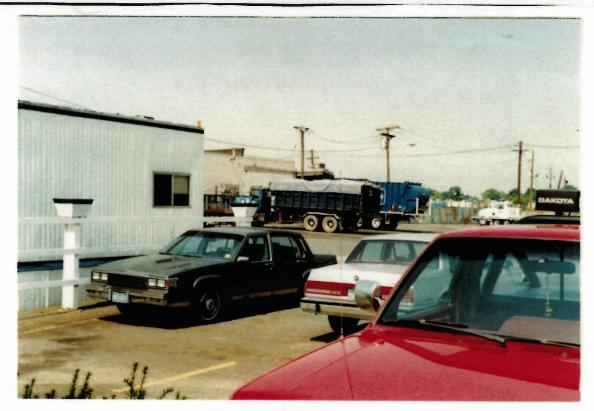


Photo 9:

Empty solid waste disposal hauling vehicle parking area.





Photo 10:

View of facility looking northwest.

Time: 11:55

CDM FEDERAL PROGRAMS CORPORATION ENVIRONMENTAL PRIORITIES INITIATIVE BROWNING - FERRIS INDUSTRIES ELIZABETH, NEW JERSEY

Photograph Log



Photo 11: View of facility entrance looking out into Division St. towards the southeast.

Time: 11:55

CDM FEDERAL PROGRAMS CORPORATION ENVIRONMENTAL PRIORITIES INITIATIVE BROWNING - FERRIS INDUSTRIES ELIZABETH, NEW JERSEY

Photograph Log

REFERENCE NO. 1

C. W. Fetter

Applied
Hydrogeology
Second Edition



SI system of units hydraulic conductivity is in meters per day. A derived unit of gallons per day per square foot was used in the past. It can be converted to feet per day by dividing by 7.48.

4.3.3 PERMEABILITY OF SEDIMENTS

Unconsolidated coarse-grained sediments represent some of the most prolific producers of ground water. Likewise, clays are often used for engineering purposes, such as lining solid-waste disposal sites, because of their extremely low intrinsic permeability. There is obviously a wide-ranging continuum of permeability values for unconsolidated sediments (Table 4.5).

The intrinsic permeability is a function of the size of the pore opening. The smaller the size of the sediment grains, the larger the surface area the water contacts (Figure 4.13). This increases the frictional resistance to flow, which reduces the intrinsic permeability. For well-sorted sediments, the intrinsic permeability is proportional to the grain size of the sediment (25).

For sand-sized alluvial deposits, several factors relating intrinsic permeability to grain size have been noted (26). These observations would hold true for all sedimentary deposits, regardless of origin of deposition.

- As the median grain size increases, so does permeability. This is due to larger pore openings.
- 2. Permeability will decrease for a given median diameter as the standard deviation of particle size increases. The increase in standard deviation indicates a more poorly sorted sample, so that the finer material can fill the voids between larger fragments.
- 3. Coarser samples show a greater decrease in permeability with an increase in standard deviation than do fine samples.
- 4. Unimodal (one dominant size) samples have a greater permeability

TABLE 4.5 Ranges of intrinsic permeabilities and hydraulic conductivi-, ties for unconsolidated sediments/

S TOP UNCONSONICATED SCAMMENT		
Material	Intrinsic Permeability (darcys)	Hydraulic Conductivity (cm/sec)
Clay	10-6-10-3	10 ⁻⁹ -10 ⁻⁶
Silt, sandy silts, clayey sands, till Silty sands, fine sands	$10^{-3} - 10^{-1}$ $10^{-2} - 1$	$10^{-6} - 10^{-4}$ $10^{-5} - 10^{-3}$
Well-sorted sands, glacial outwash Well-sorted gravel	$1 - 10^2$ $10 - 10^3$	$10^{-3} - 10^{-1}$ $10^{-2} - 1$

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the most en neerthe r exontinuum

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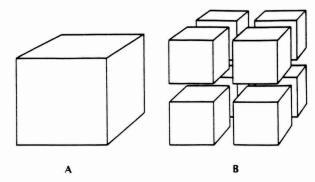


FIGURE 4.13 Relationship of sediment grain size to surface area of pore spaces. **A.** A cube of sediment with a surface area of six square units. **B.** The cube has been broken into eight pieces, each with a diameter of one-half of the cube in Part A. The surface area has increased to twelve square units—an increase of 100 percent.

than bimodal (two dominant sizes) samples! This is again a result of poorer sorting of the sediment sizes, as the bimodal distribution indicates.

The hydraulic conductivity of sandy sediments can be estimated from the grain-size distribution curve by the **Hazen method** (27). The method is applicable to sands where the effective grain size (D_{10}) is between approximately 0.1 and 3.0 millimeters. The Hazen approximation is

$$K = C(D_{10})^2 (4-10)$$

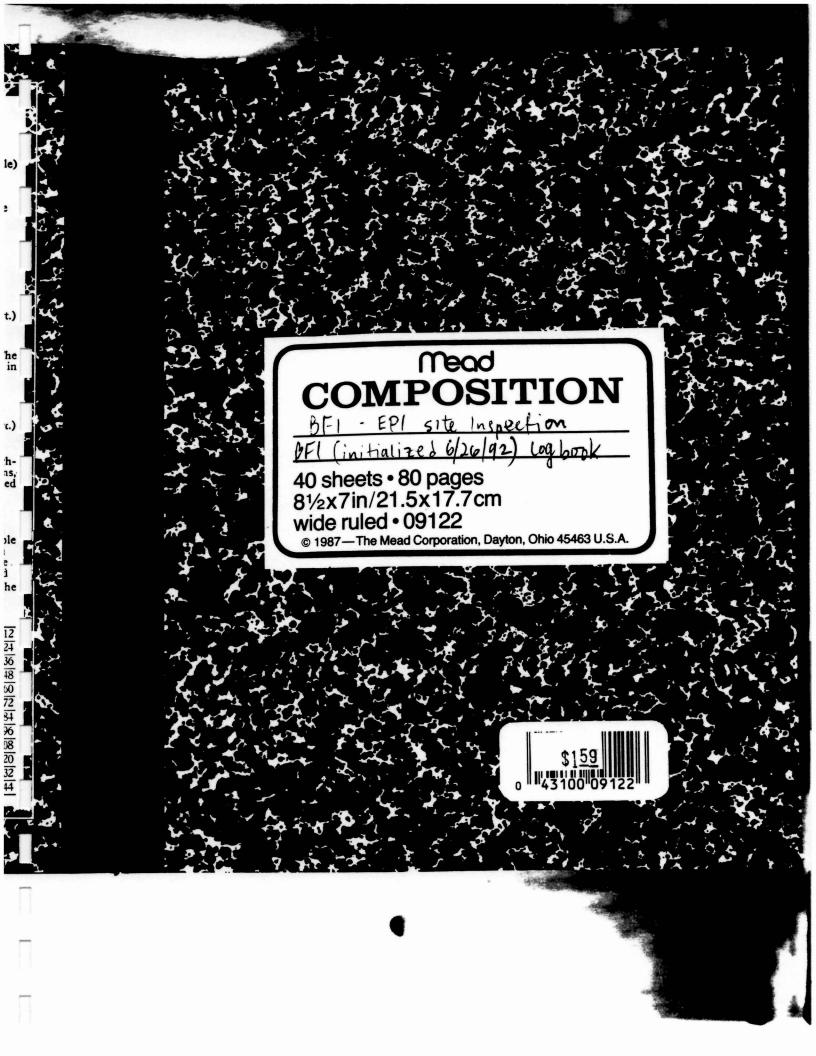
where

K is hydraulic conductivity in cm/sec D_{10} is the effective grain size in cm C is a coefficient based on the following table

Very fine sand, poorly sorted	40-80
Fine sand with appreciable fines	40-80
Medium sand, well sorted	80-120
Coarse sand, poorly sorted	80-120
Coarse sand, well sorted, clean	120-150

The Hazen method was developed on the basis of empirical studies done for the design of sand filters for drinking water. Your author has shown its hydrogeological applicability in a study of the permeability of well-sorted medium sand deposited by alluvial processes, as shown by the following case study (28). (The Hazen method may not always work as well as it did in this particular application.)

REFERENCE NO. 2



Patricia Zom 6/26/92

BFI - 714 Division St. Elizabeth, New Jersey (201) 352-2222

Patricia 20m 6/26/92

1010 Bob Pedneault and Pat Tom of

FPC arrive on site at BFI in

Elizabeth NJ (714 Divisions) for EPI
inspection (Prelimary Assessment). Hot, Sunny,

Clear 82°F.

HNh (Hazco rental) (al. by Hazeo PG
6/18/92 11.7er probe- Serial#1106

Reading background=1.0 ppm

Net with Dallid Galbraith of BFI

Regina Vicsik (site advised 1500)

Regina Vicsik (site administrative staff person),
and Marina Bouleyard, Andy Fydryszewski
all of BFI.

Irvok parking lot for BFI sarbage trucks (no waste is brought an site.) at this present time.

1727 Ticture 1 - Past transfer station (closure done) Transfer area was concrete line with containers in wait of contents from trucks that would bring in RCRA waste...

Sor solid waste a ffer the Haz wests

Patrice 7 on 6/26/92

34

Patrice 20m 6/25/92 3

1983 Haz wash closure, 1989 Solid weste transfer station closed. (Permit lapsed in 1989) - some as Picture 2 but Picture 3 looking north. Site is asphalt lined (depth of pavement not known) 20 cy containers now on site (enpty) Picture 4 - 20 cyster containers looking west. Picture 5 - trash compactor. Picture 6 - gas pump aith gas tank 12,006 gal, underground. 1035 Picture 7 - gassipump also using gas tank (12,000 gal) undreground. 1037 Picture 8 - Repair building Safety Heen Priet picks up used oil (x codes) 1038 licture 9 - area used for parking the municipat BFI solid waste truck & (all empty when on site)6/26/92

t81

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06

106

uski

no waste

nz.

os ~e

e with

& also

UC 53

(4) Patricia 20m 6/26/92

(documentation review) Since site was closed (as hazardors of the drain on site and eventually beads to the city storm drain facility was permitted to discharge.)

* Map layout of site has alot of this information.

There is a slope towards division st. by windle inspection from 08-3% (no higher.)

1155 Picture 10 - looking into facility.
1155 Picture II- looking out into street (division)

Exom inside facility.

1210 Facility site inspection concluded. Will do a drive Around the vacinity of site to further inspection.

Site to further inspection.

7 . Dolumbe

Note That Altward TSD



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF WASTE MANAGEMENT 32 E. Hanover St., CN 028, Trenton, N.J. 08625

JACK STANTON DIRECTOR LINO F. PEREIRA DEPUTY DIRECTOR

December 12, 1983

Mr. Peter A. Leonardis, District Manager Browning-Ferris Industries, Inc. 2714 Division Street Elizabeth, NJ 07207

RE: Delisting of Browning-Ferris Industries, Inc. as a Hazardous Waste Facility, EPA ID NO. NJD05817979

Dear Mr. Leonardis:

The Bureau of Hazardous Waste Engineering has reviewed your request, which is contained in your letter dated October 21, 1983, that Browning-Ferris Industries Elizabeth Transfer Station be removed by both EPA and NJDEP from the list of interim status TSD facilities. The reason given for the delisting request was that cleaning and decontamination activities were carried out at the referenced facility during December 1982 after all operations had ceased the previous month.

The cleaning and decontamination procedures in effect became a closure plan for the facility. You certified in your letter of October 21, 1983 that the BFI Elizabeth Transfer Station was closed in accordance with the decontamination procedures. Also, a report by M. Disko Associates, Consulting Engineers certified that the closure plan for the referenced facility was performed as presented in your letter.

Therefore, this Bureau has determined that your company's hazardous waste treatment, storage or disposal facility as delineated in the company's RCRA Part A application and identified by EPA ID NO. NJD058117979 has been excluded from regulation under N.J.A.C. 7:26-1.1 et seq. because your facility no longer handles hazardous waste at the site and has closed the BFI Elizabeth Transfer Station according to a DEP approved closure plan.

This written acknowledgement of the exclusion of the above identified facility from N.J.A.C. 7:26-1 et seq. is based expressly on the review of the aforementioned correspondence. This letter makes no claim as to the extent and physical condition of the actual hazardous waste activities occurring at the site mentioned above. To operate a hazardous waste facility without prior approval from the DEP is a violation of the Solid Waste Management Act N.J.S.A. 13:1E-1 et seq.

As a result of the conclusions previously made, this Bureau is of the opinion that the Notice of Violation: Failure to Establish Financial Assurance for Closure and Post-Closure and to Demonstrate Financial Responsibility for Claims dated August 31, 1983 and signed by Mr. Daid Shotwell has been satisfactorily complied with.

If you have any further questions on this matter, please contact Mr. Benjamin Esterman of my staff at (609) 984-4061.

Very truly yours,

Frank Coolick, Chief

Bureau of Hazardous Waste Engineering

EP14/ch

c: Joel Golumbek, USEPA

Dave Shotwell, DWM

State of New Jersey

Suting y prey. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Show with DEDUCATION OF ST DIVISION OF WASTE MANAGEMENT 32 E. Hanover St., CN 028, Trenton, N.J. 08625

0 8 DEC 1900

LING E PEREIRA DEPUTY DIRECTOR

JACK STANTON DIRECTOR

> Mr. Peter A. Leonardis, District Manager Browning-Ferris Industries, Inc. 714 Division Street Elizabeth, NJ 07207

RE: Closure Plans for Elizabeth Transfer Station, Browning-Ferris Industri Inc., Elizabeth, Union County, New Jersey, RCRA Facility No. NJD058227979, NJ Project No. CP-83-15

NJD058117979

Dear Mr. Leonardis:

This letter is in response to your submittal dated October 21, 1983 in which you requested approval of closure plans for a hazardous waste transfer station located at:

> 714 Division Street Elizabeth, Union County, New Jersey

The New Jersey Department of Environmental Protection (NJDEP), on behalf of the United States Environmental Protection Agency (EPA), has reviewed the submitted closure plans and finds them in compliance with the criteria set forth in Subchapter 9 of N.J.A.C. 7:26 and Subpart G of 40 CFR Part 265, and is agreeable to your request.

Therefore, Browning-Ferris Industries, Inc. is hereby authorized to close the Elizabeth Transfer Station as stated in the closure plans, subject to the following conditions:

- 1) Clean by sandblasting all surfaces at the transfer station which may have come in contact with hazardous waste. These surfaces include the concrete deck, steel wall plates, and concrete or asphalt pavements at grade level.
- Clean by sandblasting all steel containers that were used to transport or hold any hazardous wastes.
- All sandblasting residue as well as any hazardous waste material? removed from the transfer station and containers shall be collected and shipped off-site to an authorized disposal facility.

- 4) Any containers from which contaminants cannot be completely removed by sandblasting shall be taken away from the site to an authorized facility.
- 5) In order to assure that contaminants have been removed from all surfaces, representative samples of the surfaces shall be taken after cleaning and the following analyses performed on these samples:
 - a) Ignitability
 - b) Corrosivity, pH
 - c) Reactivity
 - d) EP Toxicity Test for Metals

- e) EP Toxicity Pesticides
- f) EP Toxicity Herbicides

All the testing must be performed by a New Jersey State Certified Testing Laboratory.

- 6) The owner or operator shall complete closure activities within 180 days of the date of this approval.
- 7) When closure is completed, the owner or operator shall submit to the NJDEP certification both by the owner or operator and by an independent registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure plan.

Should you have any questions on this matter, please contact the Bureau of Hazardous Waste Enginering at (609) 292-9880.

Very truly yours,

Edward Jacondres Assistant Director Engineering

EP3/EP14/ch

C:

ANALYTICAL REPORT

November 24, 1980

TO:

Jim Goodkin

FROM:

Houston Laboratory

RE:

Analysis of Storm Sewer Water from BFI Elizabeth, N.J.-BFI 11416.

ANALYSIS

	Molybdenum, mg/l Manganese, mg/l	<0.1 1.5
	Sulfate, mg/l	575
,	Sulfide, mg/l	<0.1
	Aluminum, mg/l	<0.05
	Barium, mg/1	0.3
•		0.13
	Cobalt, mg/l	26
	Boron, mg/l	0.44
	Iron, mg/l	0.83
	Magnesium, mg/l	750
	Chemical Oxygen Demand, mg/l	265
	Total Organic Carbon, mg/l	497
	Total Suspended Solids, mg/l	41
	Ammonia, mg/l	300
	Color, APHA units	
	Fluoride, mg/l	3.6
	Nitrate, mg/1	<0.02
	Antimony, mg/l	<0.10
•	Cadmium, mg/1	<0.010
	Oil & Grease, mg/l	805
	ABS/LAS, mg/1	47
	Arsenic, mg/l	<0.010
_	-Chromium, mg/l	<0.1
	Copper, mg/1	0.34
	Lead, mg/1	<0.1
	Mercury, mg/l	0.0040
	Nickel, mg/l	<0.10
	Selenium, mg/l	<0.010
	Silver, mg/l	<0.10
	Zinc, mg/l	1.6
	Cyanide, mg/l	<0.005
	Phenol, mg/l	0.16

BFI HOUSTON LAB GROUP

Daniel W. Heintz

DWH/pc



Surface Water Quality Standards N.J.A.C. 7:9-4.1 et seq.



AUGUST 1989

New Jersey Department of Environmental Protection Division of Water Resources "Fresh water(s)" means all nontidal and tidal waters generally having a salinity, due to natural sources, of less than or equal to 3.5 parts per thousand at mean high tide.

"FW" means the general surface water classification applied to fresh waters.

"FW1" means those fresh waters that originate in and are wholly within Federal or State parks, forests, fish and wildlife lands and other special holdings, that are to be maintained in their natural state of quality (set aside for posterity) and not subjected to any man-made wastewater discharges, as designated in N.J.A.C. 7:9-4.15(h) Table 6.

"FW2" means the general surface water classification applied to those fresh waters that are not designated as FW1 or Pinelands Waters.

"Heat dissipation area" means a mixing zone, as may be designated by the Department, into which thermal effluents may be discharged for the purpose of mixing, dispersing, or dissipating such effluents without creating nuisances, hazardous conditions, or violating the provisions of this subchapter.

"Hypolimnion" means the lower region of a stratified waterbody that extends from the thermocline to the bottom of the waterbody, and is isolated from circulation with the upper waters, thereby receiving little or no oxygen from the atmosphere.

"Important species" means species that are commercially valuable (e.g., within the top ten species landed, by dollar value); recreationally valuable; threatened or endangered; critical to the organization and/or maintenance of the ecosystem; or other species necessary in the food web for the well-being of the species identified in this definition.

"Industrial water supply" means water used for processing or cooling.

"Intermittent stream" means a stream with a MA7CD10 flow of less than one-tenth (0.1) cubic foot per second.

"Lake, pond, or reservoir" means any impoundment, whether naturally occurring or created in whole or in part by the building of structures for the retention of surface water, excluding sedimentation control and stormwater retention/detention basins.

"LC50" means the median lethal concentration of a toxic substance, expressed as a statistical estimate of the concentration that kills 50 percent of the test organisms under specified test conditions, based on the results of an acute bioassay.

"Limiting nutrient" means a nutrient whose absence or scarcity exerts a restraining influence upon an aquatic biological population.

"MA7CD10" means the minimum average 7 consecutive day flow with a statistical recurrence interval of 10 years.

"Measurable changes" means changes measured or determined by a biological, chemical, physical analytical method, conducted in accordance with USEPA approved methods as identified in 40 C.F.R. 136 or other analytical methods (for example, mathematical models, ecological indices, etc.) approved by the Department, that might adversely impact a water use (including, but not limited to aesthetics).

"Mixing zones" means localized areas of surface waters, as may be designated by the Department, into which wastewater effluents may be discharged for the purpose of mixing, dispersing, or dissipating such effluents without creating nuisances or hazardous conditions, or violating the provisions of this subchapter.

"Natural flow" means the water flow that would exist in a waterway without the addition of flow of artificial origin.

"Natural water quality" means the water quality that would exist in a waterway or a waterbody without the addition of water or waterborne substances from artificial origin.

"NJPDES" means New Jersey Pollutant Discharge Elimination System.

"NOEC" means the "no observable effect concentration", which is the highest concentration of a toxic substance that has no adverse effect(s) on survival, growth, or reproduction of species based upon the results of chronic toxicity testing.

"Nondegradation waters" means those waters set aside for posterity because of their clarity, color, scenic setting, other characteristic of aesthetic value, unique ecological significance, exceptional recreational significance, or exceptional water supply significance. These waters include all waters designated as FW1 in this subchapter.

"Nonpersistent" means degrading relatively quickly, generally having a half-life of less than 96 hours.

"Nontrout waters" means fresh waters that have not been designated in this subchapter as trout production or trout maintenance. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a wide variety of other fish species.

"NPDES" means National Pollutant Discharge Elimination System.

"NT" means nontrout waters.

"Nutrient" means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the growth and development of organisms.

"Outstanding National Resource Waters" means high quality waters that constitute an outstanding national resource (for example, waters of

National/State Parks and Wildlife Refuges and waters of exceptional recreational or ecological significance) as designated in N.J.A.C. 7:9-4.15(i).

"Persistent" means relatively resistant to degradation, generally having a half life of over 96 hours.

"Pinelands waters" means all waters within the boundaries of the Pineland Area, except those waters designated as FW1 in this subchapter, as established in the Pinelands Protection Act N.J.S.A. 13:18A-1 et seq., and shown on Plate 1 of the "Comprehensive Management Plan" adopted by the New Jersey Pinelands Commission in November 1980.

"PL" means the general surface water classification applied to Pinelands Waters.

"Primary contact recreation" means recreational activities that involve significant ingestion risks and includes, but is not limited to, wading, swimming, diving, surfing, and water skiing.

"Public hearing" means a legislative type hearing before a representative or representatives of the Department providing the opportunity for public comment, but does not include cross-examination.

"River mile" means the distance, measured in statute miles, between two locations on a stream, with the first location designated as mile zero. Mile zero for the Delaware River is located at the intersection of the centerline of the navigation channel and a line between the Cape May Light, New Jersey, and the tip of Cape Henlopen, Delaware.

"Saline waters" means waters having salinities generally greater than 3.5 parts per thousand at mean high tide.

"SC" means the general surface water classification applied to coastal saline waters.

"SE" means the general surface water classification applied to saline waters of estuaries.

"Secondary contact recreation" means recreational activities where the probability of water ingestion is minimal and includes, but is not limited to, boating and fishing.

"Shellfish" means those mollusks commonly known as clams, oysters, or mussels.

"Shellfish waters" means waters classified as Approved, Seasonally Approved, Special Restricted, Seasonally Special Restricted or Condemned that support or possess the potential to support shellfish which are within the Coastal Area Facility Review Act (C.A.F.R.A.) zone as delineated in 1973, (excluding: 1 - The Cohansey River upstream of Brown's Run; 2 - The Maurice River upstream of Route 548;

3 - The Great Egg Harbor River upstream of Powell Creek; 4 - The Tuckahoe River upstream of Route 50; 5 - The Mullica River upstream of the Garden State Parkway) plus the adjacent areas between Route 35 (from its juncture with the C.A.F.R.A. zone just north of Red Bank to its juncture with the C.A.F.R.A. zone just south of Keyport) and the C.A.F.R.A. zone and the area from the C.A.F.R.A. zone on the south northwesterly along Route 35 to the northern shore of the Raritan River, then easterly along the northern shore of the Raritan River to the southeast point of Perth Amboy, then due east to the New Jersey jurisdictional limit, and seaward along the jurisdictional limit to the Atlantic Ocean.

"Stream temperature" means the temperature of a stream outside of a designated heat dissipation area.

"Surface water classifications" means names assigned by the Department in this subchapter to waters having the same designated uses and water quality criteria (e.g. FW1, PL, FW2-NT, SE1, SC, Zone 1C).

"Surface Water Quality Standards" means the New Jersey rules which set forth a designated use or uses for the waters of the State, use classifications, water quality criteria for the State's waters based upon such uses, and the Department's policies concerning these uses, classifications and criteria.

"Thermal alterations" means the increase or decrease in the temperature of surface waters, above or below the natural, that may be caused by the activities of man.

"Thermocline" means the plane of maximum rate of change in temperature with respect to depth.

"Tidal waters" means fresh or saline water under tidal influence, up to the head of tide.

"TM" means trout maintenance.

"TP" means trout production.

"Toxic substances" means those substances, or combination of substances, which upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly through food chains, will, on the basis of the information available to the Department, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions, including malfunctions in reproduction, or physical deformation, in such organisms or their offspring.

"Trout maintenance waters" means waters designated in this subchapter for the support of trout throughout the year.

"Trout production waters" means waters designated in this subchapter for use by trout for spawning or nursery purposes during their first summer.

7:9-4.15 Surface water classifications for the waters of the State of New Jersey

- (a) This section contains the surface water classifications for the waters of the State of New Jersey. Surface water classifications are presented in tabular form. Subsections (c) through (g) contain surface water classifications by major drainage basin. Subsection (h) lists FW1 waters by tract within basins and subsection (i) identifies the outstanding national resource waters of the State.
- (b) The following are instructions for the use of Tables 1 through 5 found in N.J.A.C. 7:9-4.15(c) through (g) respectively:
- 1. The surface water classification tables give the surface water classifications for waters of the State. Surface waters of the State and their classification are listed in the Table covering the major drainage basin in which they are located. The major drainage basins are:
- i. The Atlantic Coastal drainage basin which contains the surface waters listed in Table 1 in (c) below;
- ii. The Delaware River drainage basin which contains the surface waters listed in Table 2 in (d) below;
- iii. The Passaic River, Hudson River and New York Harbor Complex drainage basin which contains the surface waters listed in Table 3 in (e) below;
- iv. The Raritan River and Raritan Bay drainage basin which contains the surface waters listed in Table 4 in (f) below; and
- v. The Wallkill River drainage basin which contains the surface waters listed in Table 5 in (g) below.
- 2. Within each basin the waters are listed alphabetically and segment descriptions begin at the headwaters and proceed downstream.
 - 3. To find a stream:
 - i. Determine which major drainage basin the stream is in;
- ii. Look for the name of the stream in the appropriate Table and find the classification;
- iii. For unnamed or unlisted streams, find the stream or other waterbody that the stream of interest flows into and look for the classification of that stream or waterbody. The classification of the stream of interest may then be determined by referring to (b)5 below. If the second stream or waterbody is also unlisted, repeat the process until a listed stream or waterbody is found. Use (b)5iv below to classify streams entering unlisted lakes.
 - 4. To find a lake or other non-stream waterbody:
 - i. Determine which major drainage basin the waterbody is in;
 - ii. Look for the waterbody name in the appropriate Table;
- iii. If the waterbody is not listed, use (b)5ii, 5iii, 5vi, and 5vii below to determine the appropriate classification.
- 5. To find unnamed waterways or waterbodies or named waterways or waterbodies which do not appear in the listing, use the following instructions:

i. Unnamed or unlisted freshwater streams that flow into streams classified as FW2-TP, FW2-TM, or FW2-NT take the classification of the classified stream they enter, unless the unlisted stream is a PL water which is covered in (b)5vii below.

If the stream could be a C1 water, see (b) 5vi below.

ii. All freshwater lakes, ponds and reservoirs that are five or more acres in surface area, that are not located entirely within the Pinelands Area boundaries (see (b)5vii below) and that are not specifically listed as FW2-TM are classified as FW2-NT. This includes lakes, ponds and reservoirs on segments of streams which are classified as FW2-TM or FW2-TP such as Saxton Lake on the Musconetcong River. If the waterbody could be a C1 water, also check (b)5vi below.

iii. All freshwater lakes, ponds and reservoirs, that are less than five acres in surface area, upstream of and contiguous with FW2-TP or FW2-TM streams, and which are not located entirely within the Pinelands Area boundaries (see(b)5vii below) are classified as FW2-TM. All other freshwater lakes, ponds and reservoirs that are not otherwise classified in this subsection or the following Tables are classified as FW2-NT. If the

waterbody could be a C1 water, also check (b) 5vi below.

iv. Unnamed or unlisted streams that enter FW2 lakes, ponds and reservoirs take the classification of either the listed tributary stream flowing into the lake with the highest classification or the listed tributary stream leaving the lake with the highest classification, whichever has the highest classification, or, if there are no listed tributary or outlet streams to the lake, the first listed stream downstream of the lake. If the stream is located within the boundaries of the Pinelands Area, see (b) 5vii below; if it could be a C1 water, also see (b) 5vi below.

v. Unnamed or unlisted saline waterways and waterbodies are classified as SE1 in the Atlantic Coastal Basin. Unnamed or unlisted saline waterways which enter SE2 or SE3 waters in the Passaic, Hackensack and New York Harbor Complex basin are classified as SE2 unless otherwise classified within Table 3 in (e) below. Freshwater portions of unnamed or unlisted streams entering SE1, SE2, or SE3 waters are classified as FW2-NT. This only applies to waters that are not PL waters (see (b)5vii below). If the waterbody or waterway could be a C1 water, also see (b)5vi below.

Vi. If the waterway or waterbody of interest flows through or is entirely located within State parks, forests or fish and game lands, Federal wildlife refuges, other special holdings, or is a State shellfish water as defined in N.J.A.C. 7:9-4, the Department's maps should be checked to determine if the waterbody of interest is mapped as a Cl water. If the waterway or waterbody does not appear on the United States Geological Survey quadrangle that the Department used as a base map in its designation of the Cl waters, the Department will determine on a case-by-case basis whether the waterway or waterbody should be designated as Cl.

vii. All waterways or waterbodies, or portions of waterways or waterbodies, that are located within the boundaries of the

Pinelands Area established at N.J.S.A. 13:18A-11a are classified as PL unless they are listed as FW1 waters in Table 6 in (h) below. A tributary entering a PL stream is classified as PL only for these portions of the tributary that are within the Pinelands Lakes are classified as PL only if they are located entirely within the Pinelands Area.

The following 10 classifications are used for the sole purpose of identifying the water quality classification of the waters listed in the Tables in (c) through (h) below:

- i. "FW1" means freshwaters wholly within Federal or State lands or special holdings that are preserved for posterity and are not subject to manmade wastewater discharges.
 - ii. "FW2-TP" means FW2 Trout Production.
 - iii. "FW2-TM" means FW2 Trout Maintenance.

iv. "FW2-NT" means FW2 Non Trout.

v. "PL" means Pinelands Waters.

vi. "SE1" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9-4.12(d).

vii. "SE2" means saline estuarine waters whose designated

uses are listed in N.J.A.C. 7:9-4.12(e).

viii. "SE3" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9-4.12(f).

ix. "SC" means the general surface water classification

applied to saline coastal waters.

- x. FW2-NT/SE1 (or a similar designation that combines two classifications) means a waterway in which there may be a salt water/fresh water interface. The exact point of demarcation between the fresh and saline waters must be determined by salinity measurements and is that point where the salinity reaches 3.5 parts per thousand at mean high tide. The stream is classified as FW2-NT in the fresh portions (salinity less than or equal to 3.5 parts per thousand at mean high tide) and SE1 in the saline portions.
- The following water quality designations are used in Tables 1 through 5 in (c) through (g), respectively, below:

i. "(C1)" means Category 1 waters;

ii. "(tp)" indicates trout production in waters which are classified as FW1. This is for information only and does not affect the water quality criteria for those waters;

iii. "(tm)" indicates trout maintenance in waters which are classified as PL or FW1. For FW1 waters this is for information only and does not affect the water quality criteria for those waters.

(e) The surface water classifications in Table 3 are for waters of the Passaic, Hackensack and New York Harbor Complex Basin:

TABLE 3

WATER BODY	CLASSIFICATION
ARTHUR KILL (Perth Amboy) - The Kill and its saline New Jersey tributaries between the	SE2
Outerbridge Crossing and a line connecting Ferry Pt., Perth Amboy to Wards Pt., Staten Island, New York (Elizabeth) - From an east-west line	SE3
connecting Elizabethport with Bergen Pt., Bayonne to the Outerbridge Crossing (Woodbridge) - All freshwater tributaries	EWO _NM
BEAR SWAMP BROOK (Mahwah) - Entire length	FW2-NT FW2-TP(C1)
BEAR SWAMP LAKE (Ringwood)	FW2-NT(C1)
BEAVER BROOK	
(Meriden) - From Splitrock Reservoir Dam downstream to Meriden Road Bridge	FW2-TM
(Denville) - Meriden Road Bridge to Rockaway River	FW2-NT
BEECH BROOK	
(West Milford) - From State line downstream to Wanaque River	FW2-TM
BELCHER CREEK (W. Milford) - Entire length	FW2-NT
BERRYS CREEK (Secaucus) - Entire length BLACK BROOK	FW2-NT/SE2
(Meyersville) - Entire length, except segment	77.10
described below	FW2-NT
(Great Swamp) - Segment and tributaries	FW2-NT(C1)
within the Great Swamp National Wildlife	,
Refuge BLUE MINE BROOK	
(Wanaque) - Entire length, except segment	FW2-TM
described below	
(Norvin Green State Forest) - That portion of the stream and any tributaries within	FW2-TM(C1)
the Norvin Green State Forest BRUSHWOOD POND (Ringwood)	
BUCKABEAR POND (Newfoundland) - Pond, its	FW2-TM(C1) FW2-NT(C1)
tributaries and connecting stream to Clinton Reservoir	rwz-NI(CI)
BURNT MEADOW BROOK (Stonetown) - Entire length	FW2-TP(C1)
CANISTEAR RESERVOIR (Vernon)	FW2-TM
CANISTEAR RESERVOIR TRIBUTARY (Vernon) - The southern branch of the eastern tributary	FW1
to the Reservoir	
CANOE BROOK (Chatham) - Entire length	FW2-NT

CEDAR POND (Clinton) - Pond and all tributaries CHARLOTTEBURG RESERVOIR (Charlotteburg)	FW1 FW2-TM
CHERRY RIDGE BROOK (Vernon) - Entire length, except segments	FW2-NT
described below (Canistear) - Brook and tributaries upstream of Canistear Reservoir located entirely within the boundaries of Wawayanda State Park and the Newark Watershed lands	FW1
CLINTON BROOK (W Milford) - Source to,	FW2-NT(C1)
(Newfoundland) - Clinton Reservoir dam to	FW2-TP(C1)
Pequannock River CLINTON RESERVOIR (W. Milford) CLOVE BROOK - See STAG BROOK	FW2-TM(C1)
COOLEY BROOK (W. Milford) - Entire length, except segments	FW2-TP(C1)
described below (Hewitt) - Segments of the brook and all tributaries located entirely within	FW1(tp)
Hewitt State Forest CORYS BROOK (Warren) - Entire length	FW2-NT
CRESSKILL BROOK (Alpine) - Source to Duck Pond Rd. bridge,	FW2-TP(C1)
Demarest (Demarest) - Duck Pond Rd. bridge to Tenakill Brook	FW2-NT
CUPSAW BROOK (Skylands) - Source to Wanaque Reservoir,	FW2-NT
except segment described below (Skylands) - That segment of Cupsaw Brook within the boundaries of Ringwood State	FW2-NT(C1)
Park DEAD RIVER (Liberty Corners) - Entire length DEN BROOK (Denville) - Entire length DUCK POND (Ringwood)	FW2-NT FW2-NT FW2-NT(C1)
ELIZABETH RIVER	FW2-NT
Elizabeth and all freshwater tributaries (Elizabeth) - Broad St. bridge to mouth FOX BROOK (Mahwah) - Entire length GLASMERE POND (Ringwood) GOFFLE BROOK (Hawthorne) - Entire length GRANNIS BROOK (Morris Plains) - Entire length	SE3 FW2-NT FW2-NT(C1) FW2-NT FW2-NT
GREAT BROOK (Chatham) - Entire length, except segment	FW2-NT
described below (Great Swamp) - Segment within the boundaries of the Great Swamp National Wildlife Refuge	FW2-NT(C1)
GREEN BROOK (W. Milford) - Entire length, except those segments described below	FW2-TP(C1)

RESEARCH AND CONSULTING, INC.

591 SOMERSET STREET, NORTH PLAINFIELD, N. J. 07060 . (201) 757-1137

Movember 12, 1980

Browning-Ferris Industries of N.J., Inc. 1075 Central Ave.

Clark, N.J. 07066

NPDES Analysis - Elizabeth Transfer Station

Attn.: Mr. Goodkin

Gentlemen:

Herewith our findings for the analysis of one sample from Elizabeth Transfer Station received here October 22, 1980:

Figures generally

TRC Sample: 9100

Source:

in ppm. or mg/1.

Grab Sample - Storm Sewer, Elizabeth Transfer Stat

Titanium

Less than 0.05

(none detected)

Phosphorus

21.8

Sulfite

86.5

Tin

Less than 0.05

(none detected)

BOD, 5-day

630

Beryllium

Less than 0.005

(none detected)

Bromide

Less than 10

(none detected)

Chlorine

Less than 0.01

240

(none detected)

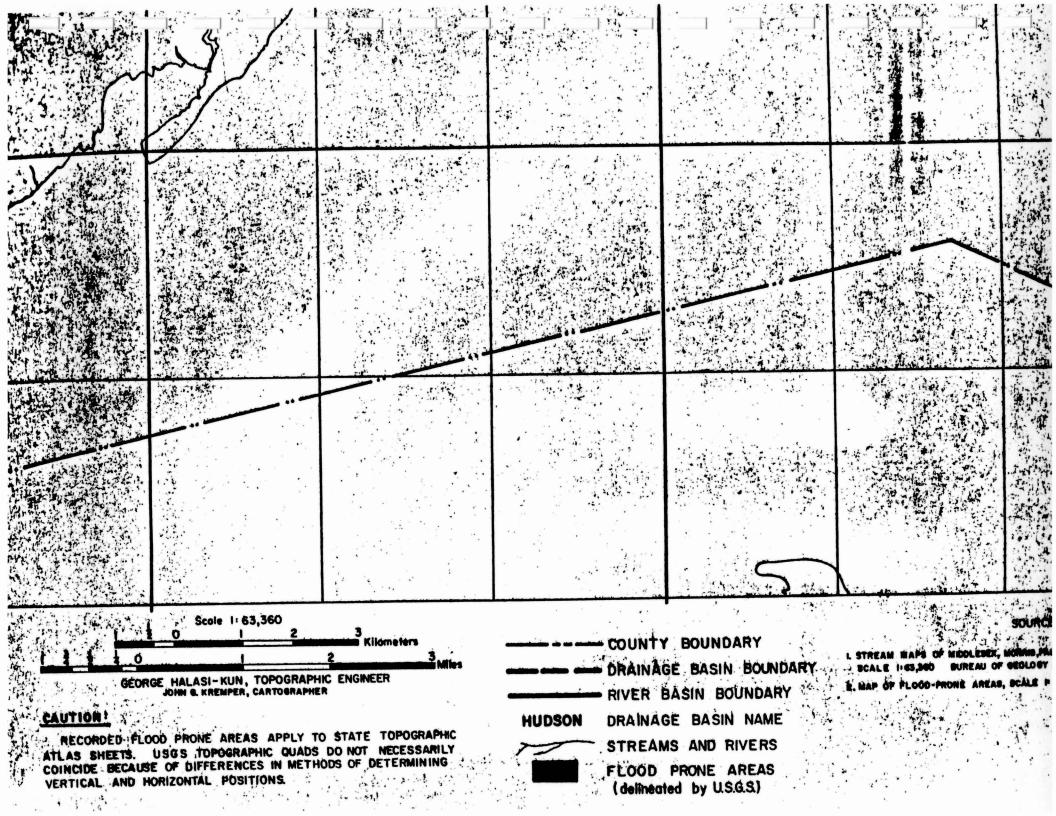
Thorium

Less than 0.5

(none detected)

Fecal coliform bacteria, MPN/100 ml.

Gary J. Gilber







URBAN AND BUILT-UP LAND

- II RESIDENTIAL
- COMMERCIAL & SERVICES
- 13 INDUSTRIAL
- 14 TRANSPORTATION, COMMUNICATION & UTILITIES
- 15 INDUSTRIAL & COMMERCIAL COMPLEXES
- IG MIXED URBAN & BUILT-UP LAND
- 17 OTHER URBAN OR BUILT-UP LAND

AGRICULTURAL LAND

21 CROPLAND & PASTURE 22 ORCHARDS & HORTICULTURAL AREAS

FOREST LAND

- 41 DECIDUOUS **42 EVERGREEN**
- 43 MIXED

WATER

- 51 STREAMS & CANALS
- 52 LAKES
- 53 RESERVOIRS
- 54 BAYS & ESTUARIES

WETLAND

- 61 FORESTED WETLAND
- 62 NONFORESTED WETLAND

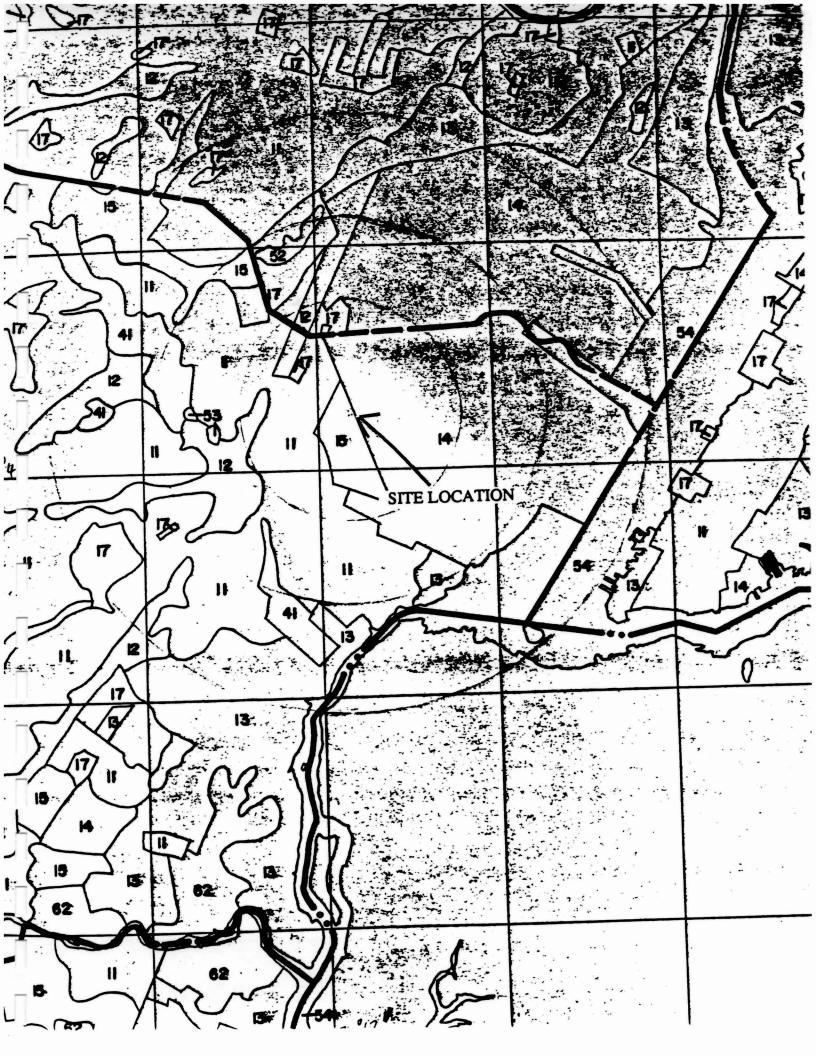
BARREN LAND

- 72 BEACHES
- 73 SAND OTHER THAN BEACHES
- 74 BARE EXPOSED ROCK
- 75 STRIP MINES, QUARRIES, & GRAVEL PITS

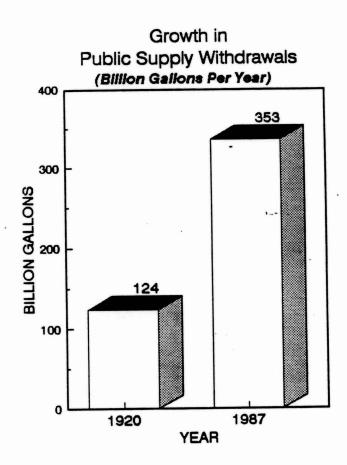
61

THE REAL PROPERTY.

BUREAU OF GEOLOGY AND TOPOGRA KEMBLE WOMER, STATE GEOLOGIST







New Jersey Department of Environmental Protection, Division of Water Resources, Bureau of Water Allocation.

INTRODUCTION

Although water withdrawal data has been collected by the New Jersey Department of Environmental Protection since the end of the last century, little has been done to summarize and report that information in the past. Because water needs in New Jersey continue to increase, it is important that water withdrawal data be made available for those who are involved in water supply planning and management.

This report utilizes data that were collected by the NJDEP's Bureau of Water Allocation to summarize the quantity of water that was withdrawn in 1987. Some information concerning water use is included in the report; however, the primary emphasis is on water withdrawals. That is because the Bureau is mainly interested in obtaining withdrawal data so that it can be used for regulating diversions as well as for modelling purposes.

In 1987, total reported water withdrawals in New Jersey amounted to approximately 601,041 million gallons. This figure excludes water use by domestic wells and other unreported sources. Ground water accounted for 230,997 million gallons (38% of the total), and surface water accounted for 370,044 million gallons (62% of the total). Only fresh-water withdrawals are included in the totals, as diversions of saline water are not required to obtain Water Allocation permits.

The 1987 Water Withdrawal Report is the first such report prepared by the Bureau of Water Allocation. However, reports involving water use in New Jersey have been published previously by other sources. Two notable reports are the "Survey of New Jersey Water Resources Development", written in 1955 for the Legislative Commission on Water Supply, and "The New Jersey Statewide Water Supply Plan", which was prepared by consultants for the NJDEP in 1980. Further data on water withdrawals dating back to 1918 has been computerized and is available through the U.S. Geological Survey.

PHYSIOGRAPHIC PROVINCES

New Jersey is made up of four physiographic provinces, each of which contains distinctive geologic and landform features. Figure 3 shows the locations of the provinces, and Table 2 summarizes ground-water use in each of these regions of the State.

The Valley and Ridge Province consists of sedimentary rocks. Sandstones, shales and limestones are all found in the region. Complex structural activity in the region has folded and faulted these formations. Long narrow ridges separated by river valleys is the characteristic landform of this region.

The Highlands Province, located to the east of the Valley and Ridge region, is primarily composed of crystalline rocks. These

formations include granite, gneiss, marble, and some sedimentary rock types similar to those found in the Valley and Ridge area. The crystalline rocks do not usually provide as much water supply as compared with the sedimentary formations found in the Valley and Ridge.

Southeast of the Highlands is the Piedmont Province. This lowland area consists of sedimentary and igneous rocks. Most of the region is composed of sandstones, siltstones, shale and conglomerate. Basalt and diabase also make up a large part of this region. These igneous rocks do no yield as much ground water as the sedimentary rocks in this region.

Glacial materials are present in each of the four provinces of the State. The Coastal Plain region contains reworked glacial materials which were deposited by rivers and lakes during sea level changes. In the remaining three provinces, glacial till, moraine and drift are present and form major sources for groundwater supplies in valleys and lowlands.

The southeastern portion of New Jersey is known as the Coastal Plain Province. This region, which begins approximate to a line running from Perth Amboy south to Trenton, is composed of unconsolidated materials. The gravels, sands, silts, and clays which make up this area range from Cretaceous to Holocene in age. Since these materials have not been subjected to the intense heat and pressure which would consolidate the material into hard rock, they are able to hold large and very consistent ground-water supplies.

Figure 2 shows how the geology of the State affects the amount of ground-water withdrawals. The Coastal Plain Province obtains approximately 71% of its supply from ground-water sources. The northern part of the State obtains most of its water supply from large streams and reservoirs, and depends on ground water for only 20% of its supply.

RECHARGE

The average annual precipitation in New Jersey is approximately 45 inches (New Jersey Legislative Commission on Water Supply, 1955). About half of that amount is lost to evapotranspiration, and another five percent is lost to direct The remaining 45%, or approximately 20 inches, surface runoff. is available for ground-water recharge. For this report, a conservative estimate of ground-water recharge has been made using a drought year recharge rate of 14 inches, which amounts to a theoretical total recharge of 5.0 billion gallons per day. In comparison, the average daily ground-water withdrawal is approximately 0.6 billion gallons. Not all of the water that is recharged remains in the aquifer; much of the recharge in the water-table aquifer flows into streams and supports their base flows. In addition, deeper aquifers are recharged at a much slower rate than water-table aquifers. In areas of high

PHYSIOGRAPHIC PROVINCES OF NEW JERSEY AND RIDGE PIEDMONT COASTAL **PLAIN** FIGURE 3



Elizabeth, N. J. District

October 10, 1989

State Of New Jersey
Department Of Environmental Protection
Division Of Solid Waste Management
CN 414
Trenton, New Jersey 08625-0414

Attn: Mr. Thomas Kearns, Chief

Bureau Of Registration and Permits Administration

Re : File No. 2004A1SP01 Transfer Station

Dear Mr. Kearns,

The attached bill concerning the above referenced facility was recently received in this office. It is being returned to the Department as the company has been notified that the permit in question has expired. Please refer to the attached letter from Mr. Kohn Castner, Chief Engineer, Engineering Element, NJDEP which is dated June 20, 1989 for further information.

The facility was not operating on June 20th and has not been in operation since.

The company does not intend to pursue a renewal application at this time.

Based on the above the company does not believe that it has any obligation to pay the July 1, 1989 registration fee. Please rescind the invoice and remove our account from your billing system.

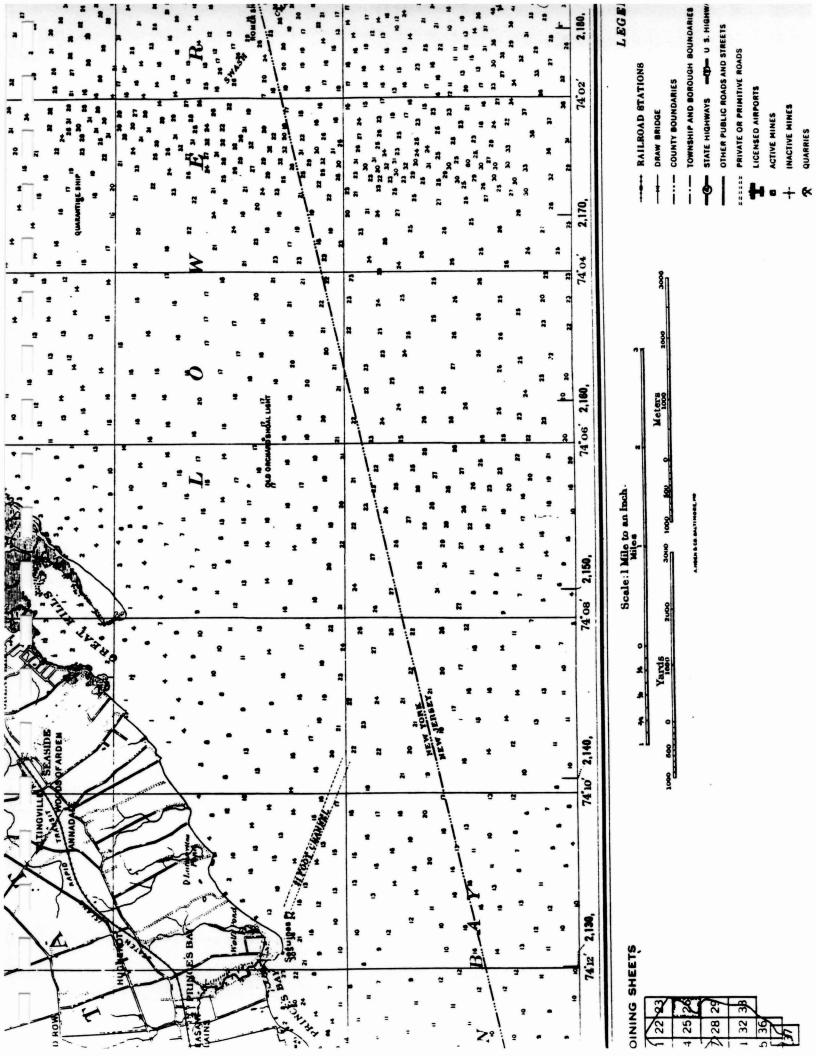
Should you have any question concerning the contents of this letter, please call or write me.

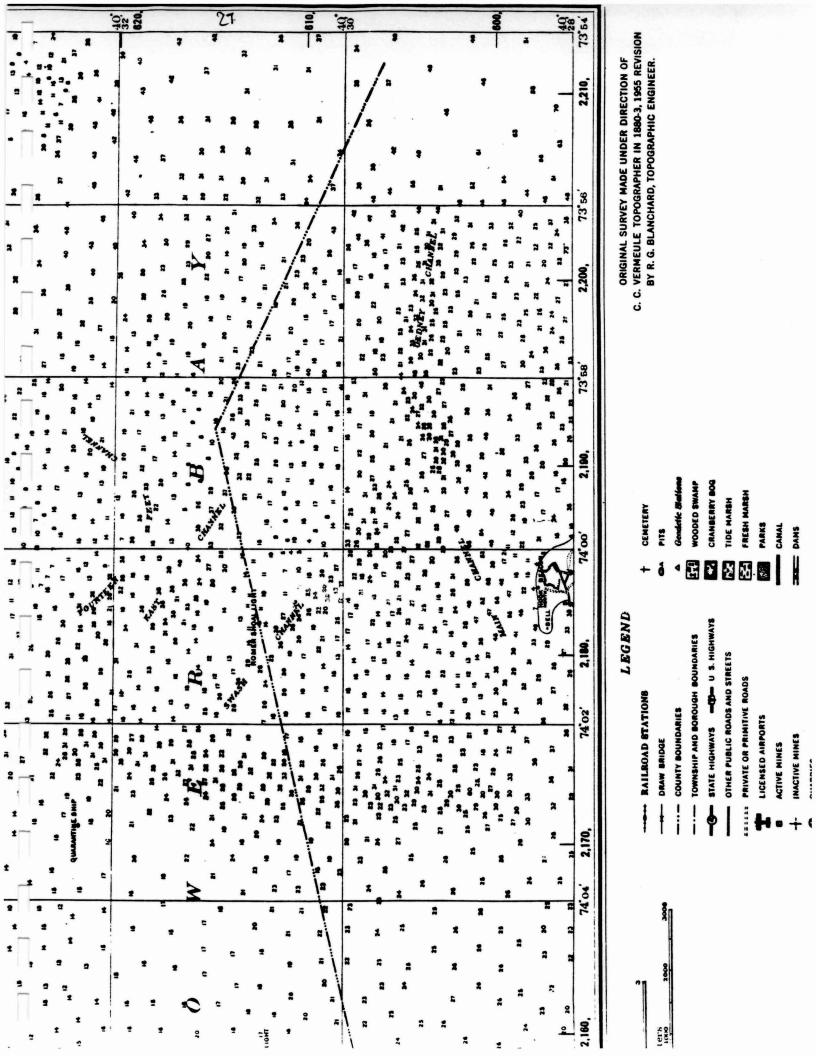
Sincerely yours,

Browning-Ferris Industries Of Elizabeth, N. J., Inc.

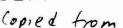
Peter A. Leonardis District Manager

cc : Arthur R. Kobin, Esq. (w encl)











Copied from BFI site Inspection 6/26/92

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF SOLID WASTE MANAGEMENT

> CN 414, Trenton, NJ, 08625-0414 Fax # (609) 394-8626

John V. Czapor Director .

JUN 2 0 1989

Mary T. Sheil Deputy Director

Mr. Arthur R. Kobin 10 Park Place Morristown, NJ 07960

RE: BFI of Elizabeth Transfer Station Application for Permit Renewal and Expansion Elizabeth, Union County Application No. 2004A

Dear Mr. Kobin:

This is in response to your letter of December 14, 1988 to Mr. Brian Petitt of my staff, and recent telephone conversations with yourself and Albert Cruz of your staff regarding the status of the above referenced transfer station application. As stated, since the applicant does not have any intention of pursuing a permit to increase the capacity of the facility, the Department is, hereby, returning the application package for the proposed 180 TPD facility expansion thus terminating the review. The Department will maintain the original application for its own records.

On the other hand, since BFI of Elizabeth intends to continue the present 85TPD operation for which its permit has expired, BFI of Elizabeth must submit to the Department an application for permit renewal pursuant to N.J.A.C. 7:26-2.7(b) reflecting the actual operation. A copy of the solid waste regulations is enclosed for your information.

Should you have any questions, please feel free to contact Julio Galarza of my staff at (609) 292-3276.

Sincerely,

John Castner, P.E., P.P.

Chief Engineer Engineering Element

JG:ec Enclosure

cc: Peter A. Leonardis, President, BFI Joseph Rogalski, DEP, Enforcement

Copied from 6/26/92 BFI site Inspection

Elizabeth, N. J. District

May 24, 1990

State of New Jersey Department of Environmental Protection Division of Solid Waste Management CN 414 Trenton, New Jersey 08625-0414

Attn: Mr. Thomas F. Kearns, Chief Bureau of Registration and

Permits Administration

Re : File No. 2004A1SP01

Dear Mr. Kearns,

Your letter and a "Statement of Quarterly Inspection and Regulation Fee" was received in this office on May 23, 1990.

On October 10, 1989 I communicated to you that the above captioned permit had expired on or about June 20, 1989. You acknowledged my communication by a letter dated November 22, 1989. Photocopies of the previous correspondence are attached.

The circumstances documented in my October 10, 1989 letter have not changed. Therefore the company does not believe that it has any obligation to pay the January 1, 1990 and prior regulation fee and it is again requested that the invoice be rescinded and that our account be removed from your billing system.

Should you have any question concerning the contents of this letter, please call or write me.

Sincerely yours,

Browning-Ferris Industries of Elizabeth, N.J., Inc.

2 Turnedil

W. Carlotte

Peter A. Leonardia Diatrict Manager

od. Jertified Mail No F 041 186 ags

714 DIVISION STREET • P. O. BOX 508 • ELIZABETH, N. J. 07207 • (201) 352-2222



January 10, 1992

Mr. Dennis Galbraith
BFI Waste Systems
Browning Ferris Industries
PO Box 508
Elizabeth, NJ 07207

Dear Mr. Galbraith:

Enclosed please find a completed Discharge Monitoring Report for the period 12/1/91 - 12/31/91. Please sign each form; send one copy to the NJDEP and one copy to the USEPA. Retain one copy for your files.

A Transmittal Sheet (Form T-VWX-014) has been included. This should be signed and sent with the DMR.

It is important that you check the information, calculations and results that we have entered on the DMR (compare them to the individual reports that we have sent) before signing. Please call us if you have any questions or find any discrepancies. There are substantial penalties for reporting incorrectly. You should also keep a reminder of your DMR due date and call us if you have not received it on time.

If you need further information, please call me at the phone number listed below.

Very truly yours,

Jane M. Puza Office Manager

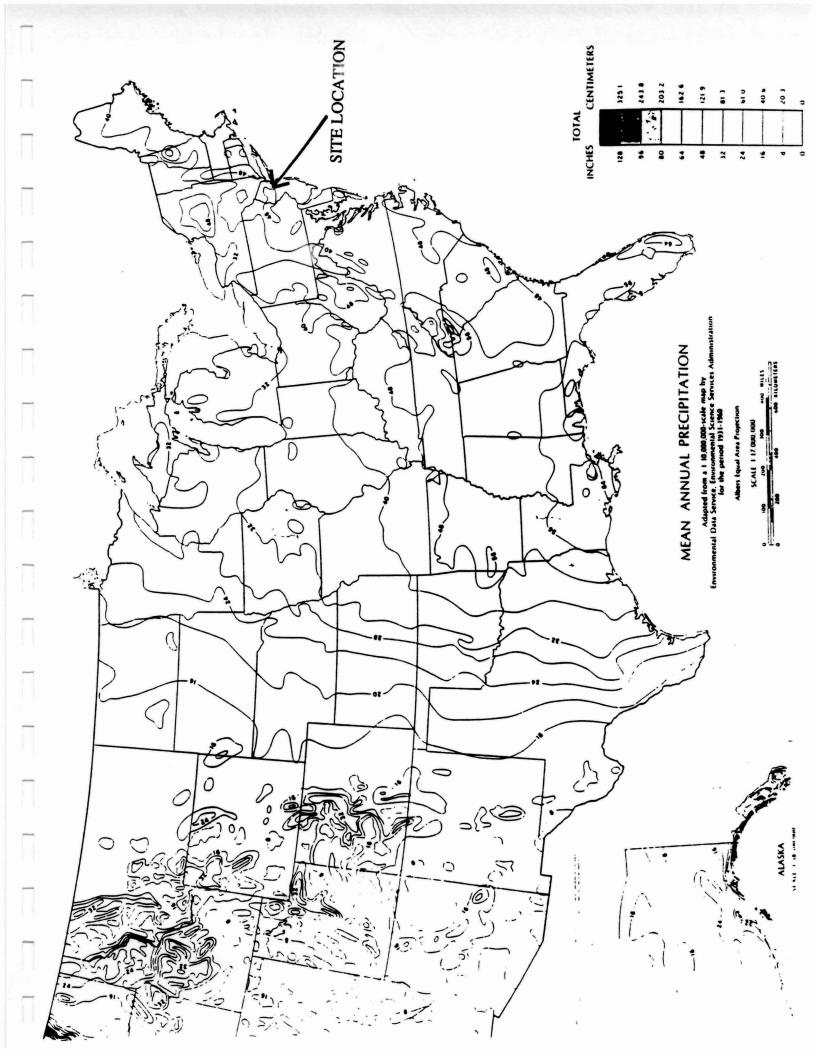
cc: Rose Spikula, BFI Linthicm, MD

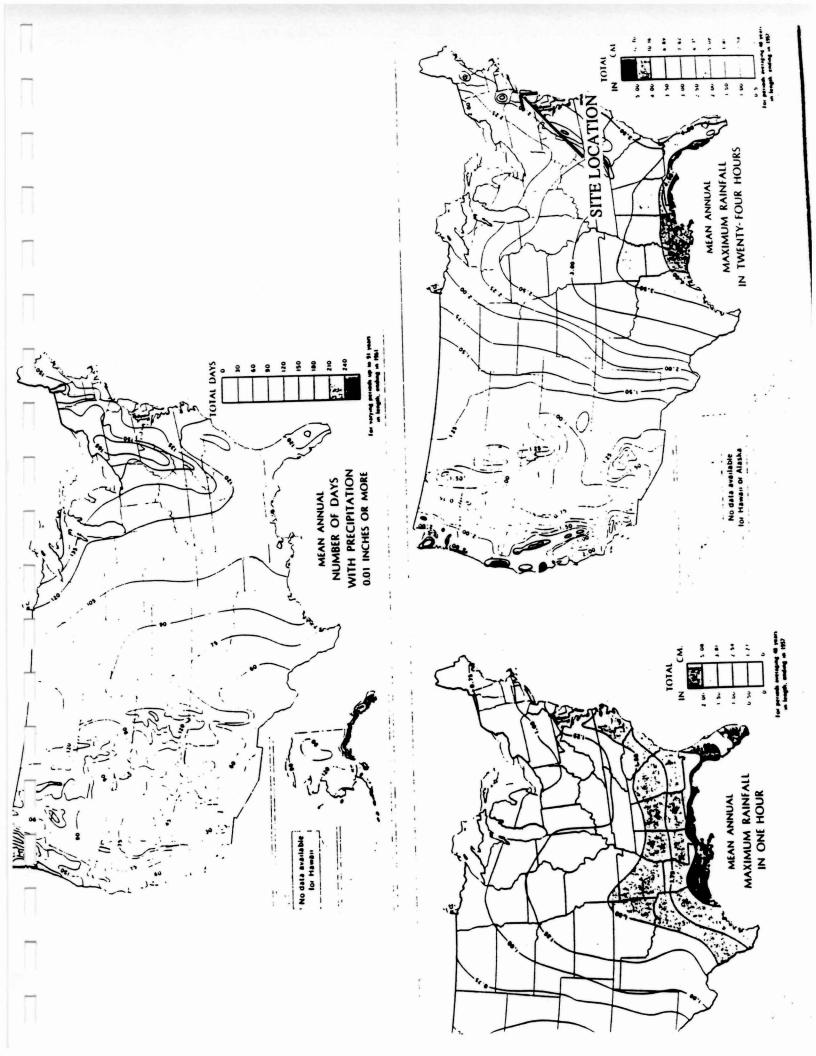
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

MONITORING REPORT - TRANSMITTAL SHEET

		NJPDES NO.	REPORTING PERIOD		
		0,0,6,2,0,5,7	[12]91] THAU [12]91]		
PERMITTEE:	Name Address .	BFI of Elizabeth NJ, I 714 Division street Elizabeth, NJ 07207-0			
FACILITY:	Name _	Browning Ferris Ind. of Elizabeth, NJ 07207-0	0508		
	Telephon	9081 352-2222	(County) I'NTON		
SLUDGE REPORTS T-VWX-007 SLUDGE REPORTS T-VWX-010 WASTEWATER REP T-VWX-011 GROUNDWATER R VWX-015(A NPOES DISCHARGE	SANITAR INDUSTRI IA T. ICATS EPORTS .31 V E MONITOR 3320-1 ON - I cert inform of the	T-VWX-009 T-VWX-0109 T-VWX-0109 T-VWX-013 WX-016 WX-016 VWX-017 ING REPORT Tify under penalty of law that mation submitted in this document in the doc	OPERATING EXCEPTIONS OYE TESTING TEMPORARY SYPASSING DISINFECTION INTERRUPTION MONITORING MALFUNCTIONS UNITS OUT OF OPERATION OTHER (Detail any "Yes" on reverse side in appropriate space.) NOTE: The "Hours Assended as Placewerse of this sheet must also be considered and all attachments and that, but the seponsible for obtaining the information unate and complete. I am aware that the seponsible for obtaining the information including the possibility of finding the possibility of finding the possibility of finding the including the possibility of finding the possibility of finding the including the possibility of finding the possibility o	ant" on a mplesed.	with the a my inquiry elieve the re significant
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Name (Printed)			Name (Printed) DENNIS G. GALE PRESIDENT	PATT	<u>u</u>
Grade & Registry N	No		Signature PRESIDENT	ou.	
Signature			Oate JANUARY 21, 1992		

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LUENT GRUSS VALUE	PERMIT	REPORT 3	REPORT DAILY MX	KG/ NAY	00000	REPORT	40-00000;	HG/L		ONCE/	GRAH
GEN DEMAND, CHEM. TGN LEVEL) (CDD) 40 L U	SAMPLE MEASUREMENT PERMIT	0.021	0.021	1	*****	14.0	14.0		0	1/30	grab
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PRIORITY WETLANDS LIST



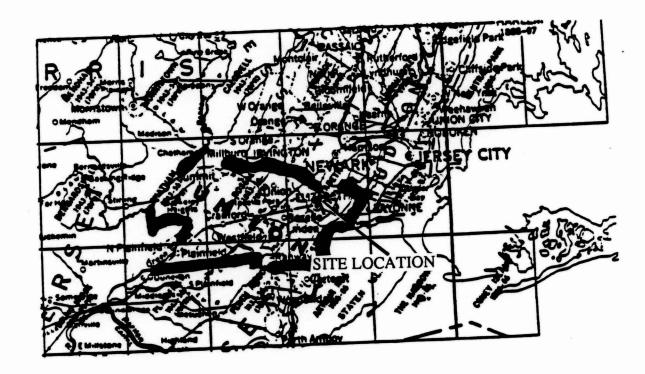
for the State of New Jersey

Prepared by the

U.S. Environmental Protection Agency

Region 2

UNION COUNTY, NJ



Name: Raritan Bay and NY Harbor (Jersey City Area)

Category: Specific Geographic Area.

State(s): New Jersey

Location: Middlesex, Monmouth, and Union Counties

Resource Value: -Estuarine wetlands, fringe salt marsh, phragmites, marsh, and aquatic habitats.

-Pollution absorption

-The regional scarcity of wetlands in this area

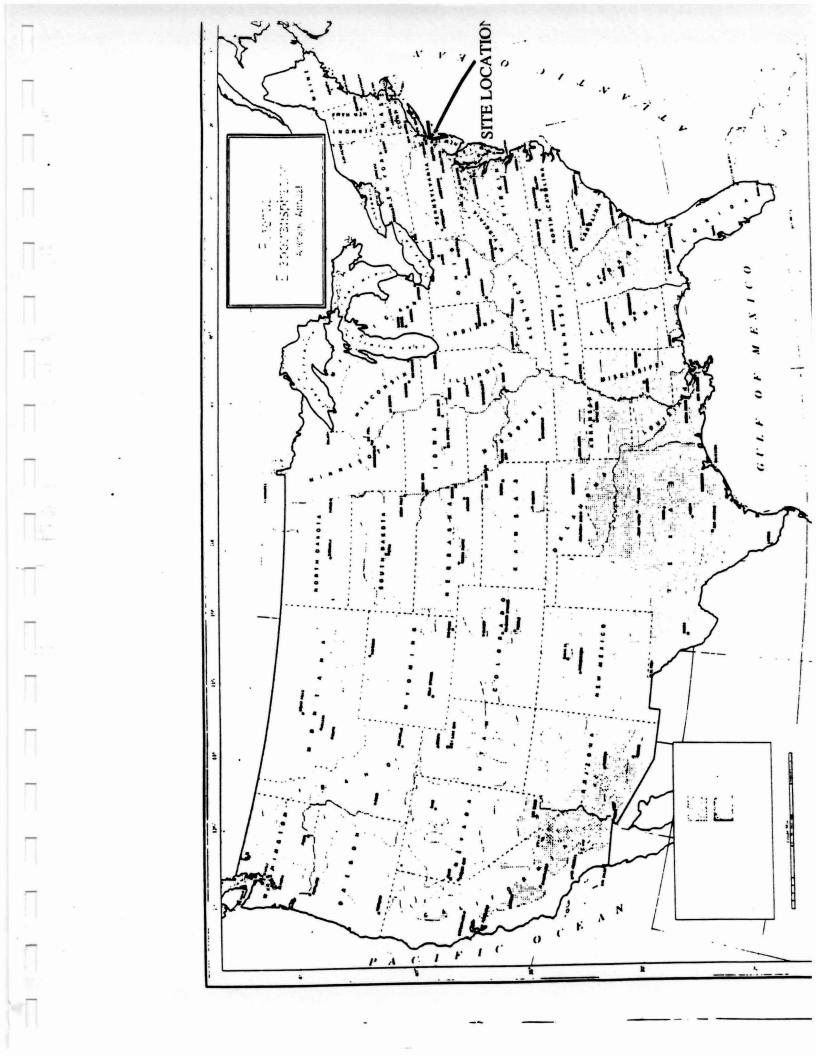
Known/Potential

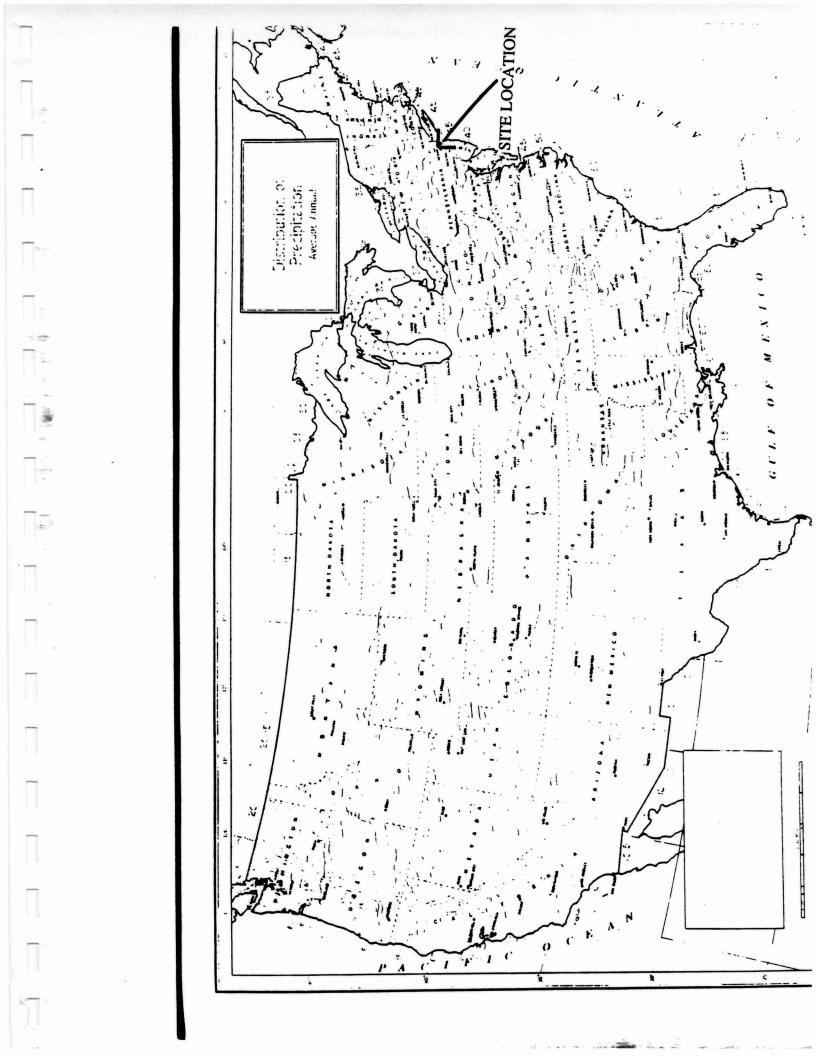
Threats to Resource: Extreme pressure from commercial and

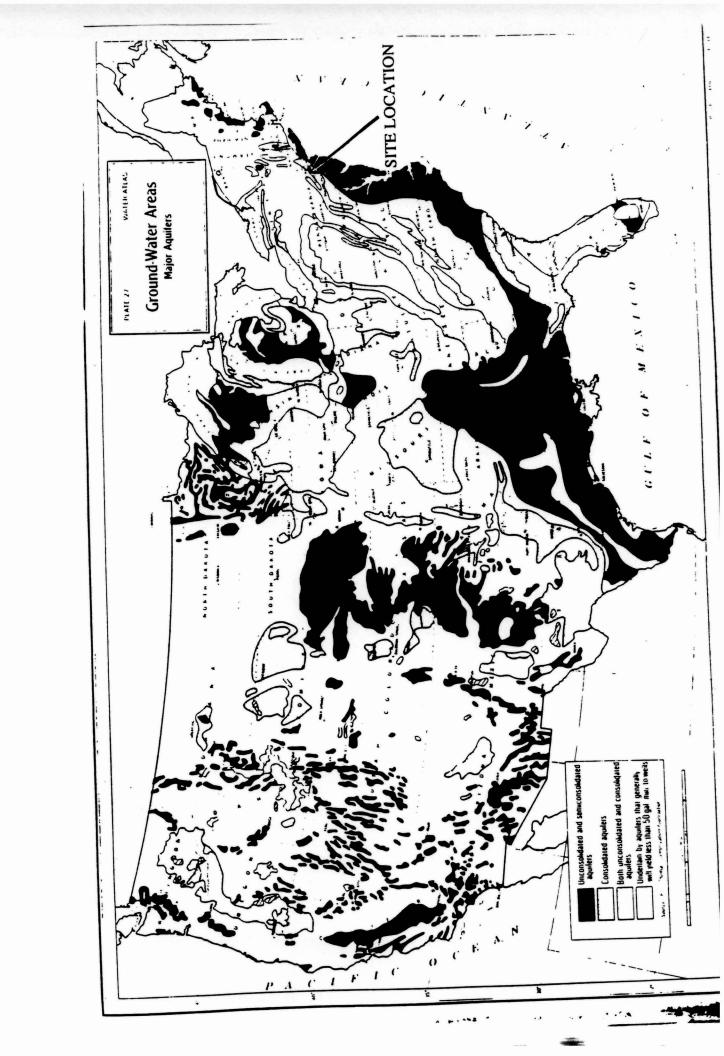
residential development.

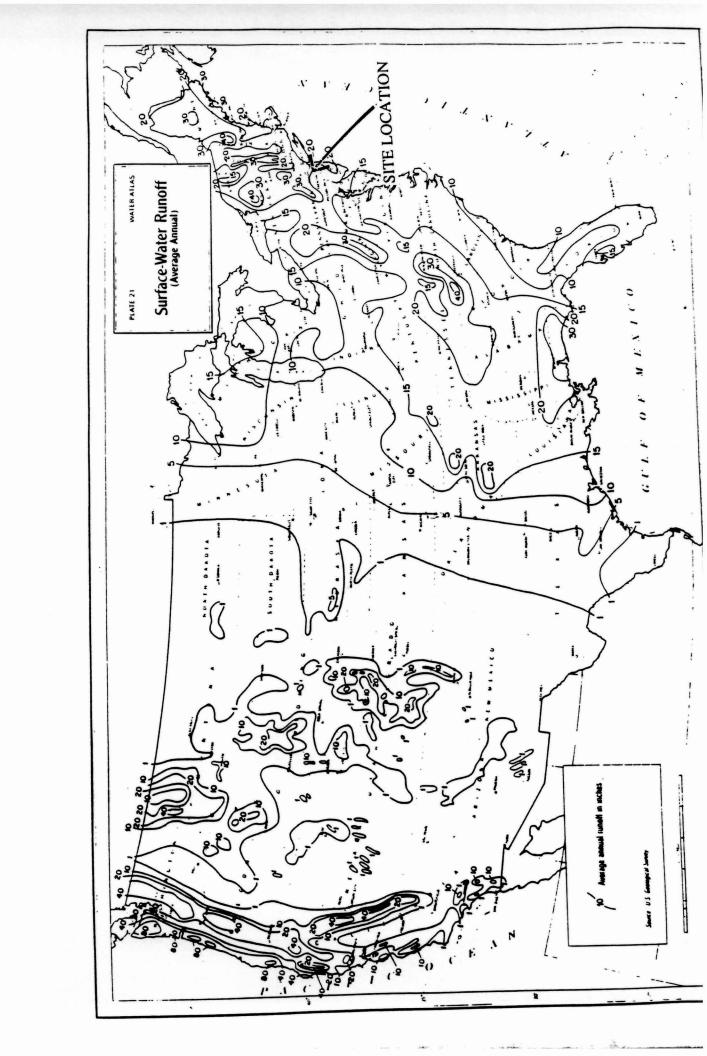
Comments:











DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

26-22-5747
Permit No. 26-3056
Application No.
County

ı.	OWNER LANDAT ACTS FARRIC CO. ADDRESS JOH WOODRUSS LANG, ELIZ. N.
	Owner's Well No. ONE SURFACE ELEVATION (Above mean see level)
2.	A CONTRACTOR OF THE CONTRACTOR
3.	DATE COMPLETED Sept 19. 1965 DRILLER PETE Chapitelli
١.	DIAMETER: top 8 Inches Bottom 8 Inches TOTAL DEPTH 600 Feet
5.	CASING: Type Skel DRIVE-PIPE Diameter 8 Inches Length 50 Feet
6.	SCREEN: Type Size of Opening Diameter Inches Length Feet
	Range in Depth Top Feet Geologic Formation Geologic Formation Feet
	Tail piece: DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Minute at Feet above surface
	Water rises toFeet above surface
١.	RECORD OF TEST: Date Sept. 15, 1965 Yield 30 Gallons per minute
	Static water level before pumping
	Pumping level 200 feet below surface afterhours pumping
	Drawdown 184 Feet Specific Capacity Gals. per min. per ft. of drawdown
	Now Pumped TURBINE PAND How measured DRUM
	Observed effect on nearby wells
9.	PERMANENT PUMPING EQUIPMENT:
	Type SUB. TURBINE HETS. Hame DEMING
	Capacity 50 G.P.M. How Driven E/ec H.P. 10 R.P.M. 3500
	Depth of Pump in well 370 Feet Depth of Footpiece in well Feet
	Bepth of Air Line in well Feet Type of Neter on Pump SizeInches
10.	USED FOR Gallons Daily AMOUNT { Heximum Gallons Daily
11.	CHALLTY AS WATER GOOD
	Taste HARD Odor No Color Clare Tone. To of
12.	LOG O-SD. Clay - Samo clay - So. 600 Nwk, TR. Are samples available? No.
13.	SOURCE OF DATA BAILER DUMPINGS.
14.	DATA OBTAINED BY Danker Date Oct. 15 1965
	(NOTE: Use other side of this shoot for additional information such as log of materials ponetrated,

Form DWR- 138 11/80 Coord: 2622753

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

10

PERMIT NO. 26-7660

APPLICATION NO. _____

Union
COUNTY_____

WELL RECORD

1,	OWNERNUNZIO NARDELLA LANDSCAPING ADDRESS 510 JERSEY AVE.	
	Owner's Well NoSURFACE ELEVATION	_Feet
2.	Owner's Well No	
3.	DATE COMPLETED	
4.	DIAMETER: Top 10 inches Bottom 6 inches TOTAL DEPTH 100	_Feet
5.	CASING: Type drive Diameter 6 Inches Length 50	Feet
6,	SCREEN: Type Size of Opening Diameter Inches Length	Feet
	Range in Depth	
	Tail Piece: Diameter Inches LengthFeet	
7.	WELL FLOWS NATURALLY Gallons per minute at Feet above surface	
	Water rises to Feet above surface	
8.	RECORD OF TEST: Date5/25/85 Yield 30 Gallons per minute	
	Static water level before pumping Feet below surface	
	Pumping level feet below surface after 8 hours pumping	
	Drawdown 60 Feet Specific Capacity 2 Gals, per min, per ft, of drawdown	
	How pumped How measured	
	Observed effect on nearby wells	
9.	PERMANENT PUMPING EQUIPMENT:	
	Type Mfrs, Name	
	Capacity G.P.M. How Driven H.P R.P.M	
	Depth of Pump in well Feet Depth of Footpiece in well Feet	
	Depth of Air Line in well Feet Type of Meter on Pump SizeInches	
10.	USED FOR Gallons Daily AMOUNT Average Gallons Daily Maximum Gallons Daily	
11.	QUALITY OF WATER good Sample: Yes No X	
	Taste none Odor none Color clear Temp of.	
12.	LOG 0-45 overburden / 45-100 red rock [Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.]	
13.	SOURCE OF DATA Somerville Well Drilling Co., Inc.	
	DATA OBTAINED BY Same Date 6/10/85	

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

DEPARTMENT OF ÉNVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

Permit No. <u>26-4727</u>
Application No.____

ADDECC AC AA BOTOMER
OWNER
OWNER
OWDEL, 2 METZ 1104
LOCATION Lot 554 Block 10 Ritesbath, W.J. DRILLER Samuel Stothoff Company Inc.
LOCATION Los 554 Block Inc. DRILLER Samuel Stothoff Company Inc.
DATE COMPLETED Wovember 22.1977 DRILLER Samuel Stothoff Company Inc. Porton 8 inches TOTAL DEPTH 570 Feet
DATE COMPLETED Wovember 22.1977 DRILLER Samuel Status 570 Feet DIAMETER: top 8 Inches Bottom 8 inches TOTAL DEPTH 570 Feet CASING: Type Size of Opening Diameter inches Length 53 Feet
Diameter
CASING: Type Size of Opening Diameter inches Length Feet
SCIEBE: 1799
TopFeet Geologic Formation
Range in Depth Research
Tail piece: Diameter Inches Feet above surface
WELL FLOWS NATURALLY Feet above surface Water rises to 9 Feet above surface Yield Gallons per minute
Water rises to Feet above surface Yield Gallons per minute
Feet below surface
hours Deroit Pull Deroit
Pumping level 316 feet below surface after 22 Pumping level 316 feet below surface after 22 Gals. per min. per ft. of drawdown Gals. per ft. p
Pumping level Specific Capacity Gals. per min. per
Provider on the second carbine meter
How measured to the massured t
Observed effect on nearby wells
Observed effect on nearby wells PERMANENT PUNPING EQUIPMENT: Type_sabsessible_turbine
Observed effect on nearby wells PERMANENT PUNPING EQUIPMENT: Type_sabsessible_turbine
Observed effect on nearby wells PERMAMENT PUMPING EQUIPMENT: Type sheersible turbine G.P.M. How Driven Capacity G.P.M. How Driven Statistic in well 483 Feet Depth of Footpiece in well Pump in well 483 Feet Type of Meter on Pump turbine Gallons Daily
Observed effect on nearby wells PERMAMENT PUMPING EQUIPMENT: Type_sheeseible_turbine
Observed effect on nearby wells PERMAMENT PUMPING EQUIPMENT: Type_sheessible_turbine
Observed effect on nearby wells PERMAMENT PUMPING EQUIPMENT: Type sheersible turbine
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type sheeseible turbins G.P.M. How Driven sleetile in well Feet Depth of Pump in well 483 Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Meter on Pump turbins Size 3 inches Average 216,000 Gallons Daily USED FOR MATER Excellent Odor Are samples available? Taste Odor Are samples available? (GISTS AGREAUS ON BECK OF Sheet or separate Feet. If electric log as made, please
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type sheeseible turbins G.P.M. How Driven sleetile in well Feet Depth of Pump in well 483 Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Meter on Pump turbins Size 3 inches Average 216,000 Gallons Daily USED FOR MATER Excellent Odor Are samples available? Taste Odor Are samples available? (GISTS AGREAUS ON BECK OF Sheet or separate Feet. If electric log as made, please
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type sheeseible turbins G.P.M. How Driven sleetile in well Feet Depth of Pump in well 483 Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Meter on Pump turbins Size 3 inches Average 216,000 Gallons Daily USED FOR MATER Excellent Odor Are samples available? Taste Odor Are samples available? (GISTS AGREAUS ON BECK OF Sheet or separate Feet. If electric log as made, please
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type sheeseible turbins G.P.M. How Driven sleetile in well Feet Depth of Pump in well 483 Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Meter on Pump turbins Size 3 inches Average 216,000 Gallons Daily USED FOR MATER Excellent Odor Are samples available? Taste Odor Are samples available? (GISTS AGREAUS ON BECK OF Sheet or separate Feet. If electric log as made, please
Observed effect on nearby wells PERMAMENT PUMPING EQUIPMENT: Type

FORM 87

DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

Permit No.	26-4434
Application	No
County	

•	Jewish Educational Center ADDRESS P. O. Box 164, Springfield, N. J
	Owner's Well No SURFACE ELEVATION (Above seen see level)
2.	LUCATIONEIIZADECH, UNION.
3.	DRILLER Somerville Well Drilling Co., Inc.
٩.	DIAMETER: top EIU Inches 6
5.	CASING: TypeDEIVE
6.	SCREEN: Type Size of Opening Diameter Inches LengthFeet
	Ton Foot
	Range in Depth { Top Feet Geologic Formation
7.	Tail piece: DiameterInches LengthFeet
••	WELL FLOWS NATURALLY Gallons per Hinute at Feet above surface
	water rises to
8.	RECORD OF TEST: Date 11/11/71 Yield 50 Gallons per minute
	Static water level before pumping
	Pumping level 80' feet below surface after 5 hours pumping
	Drawdown 60 Feet Specific Capacity 2 Gals. per min. per ft. of drawdown
	Now Pumped Kow measured Weir
	Observed effect on nearby walls
9.	PERMANENT PUMPING EQUIPMENT:
	Туре
	Canacity Afra. Name
	G.P.M. How Driven
	Feet Depth of Footpiece in well
	Feet Type of Meter on Pump Size Inches
10.	USED FOR Baptisms AMOUNT AMOUNT AMOUNT Gallons Daily Olial LTV OF WATER SOOT
	Meximum Gallons Dail
11.	ANTILL OF MAIEK BOOK
	Taste none
12.	LOS sed shale to death
	(divo details on back of shoot or on separate shoot. If electric log was made, please
13.	SOURCE OF DATA Somerville Well Drilling Co., Inc.
14.	DATA OBTAINED BY Same
	(MOTE: Use other older)
	(NOTE: Use other side of this sheet for additional infurmation such as log of materials ponetrated, analysis of the vator, sketch map, sketch of special casing arrangements etc.)

FCH # 87

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

26.22.46311

Permit No.26-1724

Application No.

1.	OWNER ORBIS PRODUCTS CCRP. ADDRESS 55 Virginia Street, Newark 5, N. J.
	Owner's Well No. 2 SURFACE ELEVATION Five (Above mean sea level)
2.	LOCATION 55 Virginia Street, Newark, N. J. 22-463
3.	DATE COMPLETED
4.	DIAMETER: top 8 Inches Botton 8 Inches TOTAL DEPTH 350 Feet
5.	CASING: Type 3/16" Tapered, Schedule 3220 laueter 8" Inches Length 157 Feet
۶.	Size of Diameter Inches Length Feet
*	Range Top Feet Geologic Formation soft shale
	Tail piece. DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY NO Gallons per Minete at Feet above surface
	Water rises toFeet above surface
٥.	RECORD OF TEST: Date Ang. 6, 1958 Yield 12 Gallons per minute
	Static water level before pumping Feet below surface
	Pumping level340feet below surface after24hours pumping
	Drawdown 340 Feet Specific Capacity Gals. per min. per ft. of drawdown
	Now Pumped Turbine Now measured timed into a drum
	Now Pumped <u>Turbine</u> Now measured <u>timed into a drum</u> Observed effect on nearby wells <u>none</u>
9.	Observed effect on nearby wells
9.	Observed effect on nearby wells
9.	Observed effect on nearby wells
9.	Observed effect on nearby wells
9.	PERMANENT PUMPING EQUIPMENT: Type deep well Nfrs. Name Deming Capacity 15 G.P.M. Now Driven Electric motor N.P 10 R.P.M
9.	PERMANENT PUMPING EQUIPMENT: Type
	PERMANENT PUMPING EQUIPMENT: Type deep well
	PERMANENT PUMPING EQUIPMENT: Type
10.	PERMANENT PUMPING EQUIPMENT: Type
10.	PERMANENT PUMPING EQUIPMENT: Type
10.	PERMANENT PUMPING EQUIPMENT: Type deep well
10.	PERMANENT PUMPING EQUIPMENT: Type deep well

mu 87 (23)

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

Permit No. G	26-2387
Application	
County	

:	OWNER S. B. P	ennick & Co	ADDRESS	Newark.	N .T
	Owner's Well No	l November Brown	SURFACE FLE	VATION	
2.	LOCATION	Menark, EXXEESSEX	CO. N.J.	2 1	
3.	DATE COMPLETED Apr	ril 27,1961 DRII	LER WI	n. Stothoff	Co. Inc.
٩,		Inches Bottom 13			
5.	CASING: Type	drive pipe	ianetar 12	Inches 1	64'10'
6.	SCREEN: Type	Size of Opening	110040-		ingthFeet
	(10			Inches Le	ingthFeet
	Range in Depth Bo	Feet 6	eologic Forma	tion	
7.	WELL FLOWS MATHRALLY	rInches	Longth	Feet	
-	Vater rises to	Gallons per M	inute at	F•	et above surface
a .	RECORD OF TEST: Date	April 27, bailer	bove surface test	Annnor of	*
	Static water lavel	April 27. bailer	Yield	Approx 24	llons per minute
	Pagaine level 100	before pumping	19	F•	et below surface
	Draidma 179	feet below sur	rface after		_hours pumping
	How Punned Bod	_Feet Specific Car	Pacity	_Gals. per min.	per ft. of drawdown
	Observed effect on a	ler	Now meas	ured	
٠.	PERMANENT PUMPING E	earby wells			
			-		
	Capacity	? Hfra.	Hane		
	Depth of Pune is we	6.P.H. How Drive	n	_ N.P	_ R.P.H
	Depth of Air Line i	Feet Dept	h of Footpiec	e in well	Feet
		n wellFeet Type	of Meter on	Pump	SizeInches
10.	USED FOR	Industrial	AMOUNT }	rage	Gallone Daily Gallone Daily
11.	QUALITY OF WATER				Gallons Daily
	Tastenone	0der none		ple: Yes	Ho
12.	LOS See oth	er side			NO NO
	(divo details on i	each of shoot or on separa	to sheet. If .	lectric led was	ando, stease
13.	SOURCE OF DATA	Well Statem	ent.		
14.	DATA OSTAINED BY_	H.J.Stot	hoff	Date	May 8,1961
	(NOTE: Use other side	of this shoot for addit	ional informatio		meteriale penetrate

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

~ /	0-517
26-	22-5136-2 408
	Permit No.
	Application No.
	County

	WELL RECORD 158 Mr. Olivet Ave
	158 Mr. Olivet Ave
١.	OWNER S. B. Pennick & Co. ADDRESS Newark, N.J.
	Owner's Well No. 2 SURFACE ELEVATION (Above mean see level)
2.	LOCATION Newark, ERREEXERY ESSEX Co. 22 - 517
3.	DATE COMPLETED June 7,1961 DRILLER Wm. Stothoff Co. Inc.
J. -	DIAMETER: top 10 Inches Bottom 10 Inches TOTAL DEPTH 2 400 Feet
••	CASING: Type drive pipe Diameter 10 inches Length 74:10" Feet
5.	
6.	SCREEN: Type Size of Diameter Inches LengthFeet
	Range in Depth { Top Feet Geologic Formation
	Tail piece: DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Hinute at Feet above surface
	Water rises toFeet above surface
s.	RECORD OF TEST: Date June 6.1961 Yield 644 Callons per minute
	Static water level before pumping 60 Feet below surface
	Pumping level 83 feet below surface after 8 hours pumping
	Drawdown 23 Feet Specific Capacity Gals. per min. per ft. of drawdown
	Now Pumped turbine pump Now measured Crifice
	Observed effect on nearby wells
9.	PERMANENT PUMPING EQUIPMENT:
	Type
	Capacity 6.P.M. How Driven N.P R.P.M
	Depth of Pump in wellFeet Depth of Footpiece in wellFeet
	Bepth of Air Line in wellFeet Type of Heter on Pump SizeInches
	USED FOR Gallons Daily AMOUNT { Average Gallons Daily Maximum Gallons Daily
0.	Maximum Gallons Daily
11.	QUALITY OF WATER Sample: Yes No
	Taste none oder none color clear Temp. 56 of
12.	See other side Are samples available? no
	(Give details on back of shoet or on asparate sheet. If electric log was made, visace furnish copy)
13.	SOURCE OF DATA Well Statement,
14.	DATA OBTAINED BY H.J.Stothoff Date June 13,1961

Coord: 2622529

Form JWR- 138 11,'40

STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

	26-8310
PERMIT NO.	

	APPLICATION Nonion
	Bernetery) Clasco.
1,	PAPETTI HYGRADE EGG_PRODUCTS- 847 NORTH AVE. OWNER ADDRESS
	Owner's Well NoSURFACE ELEVATIONFeet Lot: 1338 Block: 8 Municipality: Elizabe(4) Feet Lot: 1338 Block: 8 Feet Lot: 1338 Block: 8 Surface ELEVATION Feet Lot: 1338 Block: 8 Surface E
2.	LOCATION
3.	DATE COMPLETED 12/16/85 DRILLER Somerville Well Drilling Co.
4.	DIAMETER: Top 12 inches Bottom 8 inches TOTAL DEPTH 600 Feet
5.	CASING: Type Drive Diameter 8 Inches Length 71 Feet
6.	SCREEN: Type Size of Opening Diameter Inches LengthFeet
	Feet
	Range in Depth Top Feet Geologic Formation Geologic Formation Feet Geologic Formation
	Tail Piece: Diameter Inches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per minute at Feet above surface
	Water rises to Feet above surface
8.	RECORD OF TEST: Date 12/16/85 Yield 23 Gelffit per minute
	Static water level before pumping Feet below surface
•	Pumping level 450° feet below surface after 4 hours pumping
	Drawdown 400 Feet Specific Capacity 05 Gals, per min, per ft, of drawdown
	How pumped air How measured Weir
	Observed effect on nearby wellsNone
9.	PERMANENT PUMPING EQUIPMENT:
	Type Mfrs, Name
	Capecity G.P.M. How Driven H.P R.P.M
	Depth of Pump in well Feet Depth of Footpiece in well Feet
	Depth of Air Line in well Feet Type of Meter on Pump SizeInches
Q.	USED FOR Gallons Daily
•	Meximum Gallons Daily
•	QUALITY OF WATER GOOD Sample: YesX No
_	Teste None Odor None Color Clear Temp. of.
2.	LOG 0-51 Sand 51-600 Shale (red) Are semples available?
3.	SOURCE OF DATA Somerville Well Drilling Co.
•	DATA ORTAINED BY Same

(NOTE: Use other side of this sheet for additional information such as log of meterials panetrated, analysis of the water, sketch map, sketch of special cosing arrangements, etc.)

FORM 87- 104 211

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

Permit No. 2	16-2301
Application	
County	

1	. OWNER <u>Merl Colecom</u>	ADDRESS 849 North Avenue, Eliza beth. N
	Owner's Well No	Suprace Standard Avenue, Eliza beth. N.
		SURFACE ELEVATION (Above seen see level)
2.	LUCATIONSlizabeth	22-546
3.	DATE COMPLETED9/8/60	DRILLER Somerville toll Desire
4.	DIAMETER: top Inches Botton.	8 Inches TOTAL DEPTH 260
5.	CASING: TypeDrive	Diameter 8 Jacks Land Co.
6.	SCREEN: TypeOpening	DiameterInches LengthFeet
	TopFeet	Geologic Formation
	BottomFeet	Geologic Formation
	•	
7.	Tail piece. DiameterInch	es LengthFeet
••	Mater sizes to	er Minute atFeet above surface
_	Water rises toFe	et above surface
8.	RECURD OF TEST: Date9/8/60	YieldGallons per minute
	Static water level before pumping	30 5004 501
	rumping level	W surface after
	Drawdown 120 Feet Specific	Capacity 2 Gals. per min. per ft. of drawdown
	Now Pumped Sub	How measured Bucket
	Observed effect on nearby wells n	one
9.	PERMANENT PUMPING EQUIPMENT:	V30
		frs. Hame
	Capacity	Oriven N.P R.P.M
	Depth of Pump in well South	R.P.N
	Dooth of Air Lies is well	Depth of Footpiece in wellFeet
10.	USED FOR	Depth of Heter on Pump
	Jacobs Fox	AMOUNT Average 20,000 Gallons Daily
	•	Mexicus 24800 Callons Baily
11.	QUALITY OF WATER good	Sample: Yes Ho
	Taste none Oder	none teles
12.	LOG Red Shale	Are samples available No .
13.	SOURCE OF DATASomervil	le Well Drilling Co.
14.	DATA OBTAINED BYSome	Date9/8/60
	(NOTE: Wee other side of this shoot for	
	analysis of the vetor, sketch map, sketch	of special easing arrangements etc.)

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1,30 ,

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

APPLICATION NO. ______
Union
COUNTY_____

	OWNER
١,	OWNERADDRESS
	Owner's Well NoSURFACE ELEVATION(Above repeat see level)
2.	DATE COMPLETED 4/195 DRILLER William Stothoff
3.	DATE COMPLETED
4,	DIAMETER: Top 3 inches Bottom 420 Feet
5 .	CASING: Type Steel Diameter 8 Inches Length 55 Feet
61	SCREEN: Type Size of Opening Diameter Inches LengthFeet
	Range in Depth Top Feet Geologic Formation Red Sunds form. Geologic Formation Red Sunds form.
	Tail Piece: Diameter Inches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per minute at Feet above surface
	Water rises to Feet above surface
8.	RECORD OF TEST: Date 4/19/85 Yield 60 Sallons per minute
	Static water level before pumping Feet below surface
	Pumping level 200' feet below surface after 8 hours pumping
	Drawdown Feet Specific Capacity Gals, per min, per ft, of drawdown
	How pumpedTest pray How measured Wei?.
	Observed effect on nearby wells
9.	PERMANENT PUMPING EQUIPMENT:
	Type Submersible Mirs. Name Furbenks - mais
	Capacity 6.P.M. How Driven Electric H.P. 10 R.P.M. 3650
	Depth of Pump in well Feet Depth of Footpiece in well Feet
	Depth of Air Line in well 300 Feet Type of Meter on Pump Tarbin Size 2 Inches
10.	USED FOR AMOUNT Amount Average Gallons Daily Maximum Gallons Daily
11.	QUALITY OF WATER Sample: Yes No
	Taste Odor Color Temp OF. LOG O - 55 O LA F Guydan SS - 420' Rad Sun J6 form Are samples available? Are samples available?
12.	LOG 0-55 Our bushon CC' - 420' Red Are samples available?
	AND ACCURATIONS OF THE PARTY OF
	LDCK BUX 68
14.	DATA OBTAINED BY

Permit No. 26-138 DEPARTMENT OF CONSTRVATION Application No..... Form 87-54-4-49 AND ECONOMIC DEVELOPMENT RECEILL County Union Division of Water Policy & Supply WELL RECORD 428 Vine St. 1. OWNER...... James E. Bryon ADDRESS...... Elizabeth, W.J. 3. DATE COMPLETED March 21/50 DRILLER Wm. Stothoff Co. Inc. TOTAL DEPTH ... 255 .. Feet 4. DIAMETER: Top 8 Inches Bottom 8 Inches 5. CASING: Type drive pipe Diameter 6 Inches Length .. 2 . 34 ! 7 "Feet Length.....Feet Opening...... Diameter..... Inches 6. SCREEN: Type..... Geologic Formation.... (Top Feet Range in Depth Bottom . Feet Length.....Feet Tail piece: Diameter Inches Water rises to Feet above surface 8. RECORD OF TEST: Date. March 21/50 Yield 60 Gallons per minute Drawdown 52 Feet Specific Capacity Gala. per min. per ft. of drawdown Observed effect on nearby wells.....none-9. PERMANENT PUMPING EQUIPMENT: How Driven R.P.M. R.P.M. (Average. Gallons Daily 10. USED FOR.....Residence AMOUNT Gallons Daily Maximum. No. Sample: Yes. 11. QUALITY OF WATER. ·F Temperature . Color none Taste Done Odor none Are samples available? no 12. LOG. See other side Well Statement .. 13. SOURCE OF DATA DATE March 22, 1950 14. DATA OBTAINED BY . H.J. Stothoff (Note: Use other side of this short for additional information such as log of materials penetrated, analysis of the water, sketch map,

shotch of sporial casing arrangements, etc.)

13. 14.

STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

PERMIT NO. 36-5144	
APPLICATION NO.	
COUNTY	

WELL RECORD

1. OWNER_A.r. Gino Abbate	
	ADDRESS 136 Nurray St., Eli abeth, NJ
2. LOCATION 136 MULTAN AL EN	SURFACE ELEVATION (Above mean see level) Fee
2. LOCATION 136 Murray st., Eli abeth, 3. DATE COMPLETED = 1/20/01	Union Cty. (Above mean see level)
4. DIAMETER. T 24	DRILLER Somerville Well Drilling Co., Inc.
5 CASIAC TOP III inches Bottom	DRILLER Somerville Well Drilling Co., Inc. 6 inches TOTAL DEPTH 235 Fee
6 CODERU	6 inches TOTAL DEPTH 235 Fee Diameter 6 Inches Length 50 Fee
	Uiameter Inches
Range in Denth Top Feet	Geologic Formation
BottomFeet	Geologic Formation
Tail Piece: Diameter Inches	
7. WELL FLOWS NATURALLY	LengthFeet
7. WELL FLOWS NATURALLY Gallons per min Water rises to Feet abo	ute at Feet above surface
Fact also	Non according
8. RECORD OF TEST: Date 5/29/81 Static water level before purposes 40°	Yield 50 Gallons per minute
and service pumping	
Teet below surface	after C
For Coalf	
How pumpedair	Gals. per min. per ft. of drawdown
Observed effect on nearby wells	Gals. per min. per ft. of drawdown How measured
9. PERMANENT PUMPING EQUIPMENT:	
Туре	
Type Mi	rs. Name
TICH I IPILES	
Septi of rump in well Feet	Depth of Footpiece in well Feet
Depth of Air Line in well Feet Type of	of Meter on Pump SizeInches
10. USED FOR Domestic	SizeInches
- Domies de	AMOUNT Average Gallons Daily Maximum Gallons Daily
11. QUALITY OF WATERgood	Maximum Gallons Daily
	Complex V
12 1000'-20' clam 201 20 clam	Color_none
on back of short or on separate shore 16 store !	Are semples quillet a
13. SOURCE OF DATA Somerville Well Drilling	E Co In c.
14. DATA OBTAINED BY Same as above.	
	Dete6/17/81

(NOTE: Use other side of this sheet for additional information such as log of materials penutrated, analysis of the weter, sketch map, sketch of special casing arrangements, etc.)

FORM 67

DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

Permit No.		 	
Application	Ha	 	
County		 	

	OWNER Perk Realty Corp. ADDRESS 21/ S. First St., Elizabeth, No.
	Owner's Well No SURFACE ELEVATION (Above seen see level)
_	LOCATION Lot 219-235. South First St., Elizabeth, N.J.
	DATE COMPLETED 10/24/74 DRILLER Somerville Well Drilling Co., Inc.
3.	DIAMETER: top
١.	CASING: Type Drive Diameter 6 Inches Length 43 Feet
6.	SCREEN: Type Size of Diameter Inches LengthFeet
•	Range in Depth { TopFeet Geologic Formation
	Tail piece: DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Minute at Feet above surface
	Water rises toFeet above surface
8.	propp of TEST: nate 10/24/74 Yield 220 Gallons per minute
	Static water level before pumping Feet below surface
	Pumping level 150 feet below surface after 5 hours pumping
•	Brandown 110 Feet Specific Capacity 2 Gals. per min. per ft. of drawdown
	Now Pumped air Now measured Well
	Observed effect on nearby wells
9.	PERMANENT PUMPING EQUIPMENT:
	Type Hfrs. Hame
	Capacity 6.P.M. How Driven H.P R.P.M
	Death of Pump in wellFeet Depth of Footpiece in wellFeet
	Death of Air Line in wellFeet Type of Meter on Pump SizeInches
	AverageGallons Daily
10.	Waxinum dailons bally
11.	QUALITY OF WATER Sound Sample: Yes No. X
	Taste none Odor none Color none Temp. of
12.	(Give details on back of sheet or on separate sheet. If electric log vas made, please furnish copy)
13.	Semeralle Well Drilling Co., Inc.
14	Date 10/28/74
	(NOTE: Use other side of this shoot for additional information such as log of materials penetrated,

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPFLY

Permit No	26-1870
application	Na
County	

;,	OWNER JOE BASILLE ADDRESS 327 REDCLIFFE Owner's Well No. # 1 SURFACE ELEVATION 20 (Above sean see level)
	Owner's Well No # / SURFACE ELEVATION Feet
2.	LOCATION ELIZABETH, N.J
3.	DATE COMPLETED AUG. 15- 58 DRILLER J. GORMAN
٧.	DIAMETER: top Inches Bottom _ Inches TOTAL DEPTH 92
5.	CASING: Type STAN. BLCK Diameter C inches Length 35 Feet
6.	SCREEN: Type Size of Inches LengthFeet
	Range in Depth { Top Feet Geologic Formation TRI3
	Tail piece: DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Minute at Fact shows our fact
	Water rises to
8.	RECORD OF TEST: Date AUG 15-57 Yield 10 Gallons per minute
	RECORD OF TEST: Date AUG 15-59 Yield 10 Gallons per minute Static water level before pumping 30' Feet below surface
	TORT DOLOW SUFFACE AFTER
	Drawdown /S Feet Specific Casacity / Colores
	How Pumped BAILER How measured BARREL
	Observed effect on nearby wells NO
9.	PERMANENT PUMPING EQUIPMENT: PUMPINSTALLED BYOWNER
	Type Hfrs. Name
	Capacity G.P.M. How Driven H.P R.P.M
	Depth of Pump in wellFeet Depth of Footpiece in wellFeet
	Depth of Air Line in wellFeet Type of Heter on Pump Sizeinches
٥.	
	USED FOR DOMESTIC AMOUNT AMOUNT Average Gallons Daily
11.	QUALITY OF WATER Sample: Yes No.
	Taste GOOD Odor NONE COLOR CLEAR Tong. 570 OF
2.	(Give details on back of sheet or on separate sheet. If electric les vas made, vicase
3.	SOURCE OF DATA DRILLER
4.	DATA OBTAINED BY J. GORMAN Date AUG. 20-58
	(NOTE: Use other side of this sheet for additional information such as log of materials penetrated.

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

00-mit No.	06 3500	
Application		_
County	4.	

MER	nl Co., Inc. AD	IRFACE ELEW	TION	mabeth, H.J. F	• • t
ner's Well No		•			
CATIONPirat Stree	et, Elizabeth, A.	. Company	lle 7011	Drilling Co.	
1+01	100 21 DD	20. (CT. A)	T-T- 110	IPTH 205 E	
AMETER: topInch	nes Bottom	inches	Inches	Length 41 F	Feet
T	Diag	nater 0	Inches	Length	
CREEN: Type	_ Opening Diam	meter	Inches	Length	, t
ange in Depth { Top	Feet Geo	logic Forma	tion		
rail piece: Diameter	Inches	Length	F	••t	
THE FLOWS MATURALLY	IRE Gallons per Min	ute at		reet above sur	
	Feet abo	ove surface	•		
	Sentember 21. 19	365_ Yiel	d b		fin -
	. Gr			PARE BEIOM SAL	1.80
200	e -1 b-law and	face after_	2	hours pum	
110 .	sant Specific Cap		- Cal- ner	ser ft. of dra	AM
LEAGONU		161 ty		bucket	TAQ OA
.cylind	der	Now me	asured	Juckey	
ow Pumped cylind	der no no	Now me	asured	Juckey	TMQOM
bserved effect on nea	der no	one	asured	Juckey	TAGOR
.cylind bserved effect on nea PERMANENT PUMPING EQUI	der arby wells	one	asured	,	
bserved effect on near PERMANENT PUMPING EQUITOR	IPMENT: A P.M. How Drive	one Now me	asured	R.P.M.	
bserved effect on near PERMANENT PUMPING EQUITOR Capacity	IPMENT: Hfrs How Drive	Name	usured	R.P.H.	
ow Pumpedcylind bserved effect on nea PERMANENT PUMPING EQUI Type Capacity Depth of Pump in well	der IPMENT: G.P.H. How Drive	Name th of Footp	H.P.	R.P.H.	F
ow Pumpedcylind bserved effect on nea PERMANENT PUMPING EQUI Type Capacity Depth of Pump in well	der IPMENT: G.P.H. How Drive	Name th of Footp	H.P.	R.P.H.	F
bserved effect on near PERMANENT PUMPING EQUIPMENT PUMPING EQUIPMENT PUMPING EQUIPMENT Pumpin well bepth of Air Line in USED FOR	IPMENT: G.P.H. How Drive Feet Dept. Well Feet Type:	Name th of Footp	H.P. iece in well on Pump — Average — Haximum —	R.P.M. 11 Size Gallons	F
bserved effect on near PERMANENT PUMPING EQUIPMENT PUMPING EQUIPMENT PUMPING EQUIPMENT Pumpin well bepth of Air Line in USED FOR	IPMENT:	Name th of Foote a Mount	H.P. iece in well on Pump — Average — Haximum — Sample: Ye	R.P.M. 11 Size Gallons	F
cylind bacrved effect on nea ERMANENT PUMPING EQUI Type Capacity Depth of Pump in well Depth of Air Line in USED FOR	IPMENT:	th of Foots AMOUNT Color	H.P. iece in well on Pump — Average — Haximum —	R.P.M. 11 Size Gallons	
cylind bserved effect on nea ERMANENT PUMPING EQUITY Capacity Depth of Pump in well Depth of Air Line in USED FOR	IPMENT:	th of Footp	Average Sample: Ye clear	R.P.M. II Size Gallons Gallons es Ho Temp ples available?	F
cylind bserved effect on nea ERMANENT PUMPING EQUIT Type Capacity Depth of Pump in well Depth of Air Line in USED FOR Indus QUALITY OF WATER	IPMENT: G.P.N. Now Drive Well Feet Dept Well Feet Type Cond Co	th of Foots of Meter AMOUNT {	Average Sample: Ye clear Are sample: Are	R.P.M. II Size Gallons Gallons es Ho Temp ples available?	F

FOL 47

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

Permit No	26-4018
Application	No
County	

1.	OWNER Bristol Myers Products ADDRESS 225 Long Avenue, Hillside, N. J.
	Owner's Well No. Surface ELEVATION (Above men see level)
2.	LOCATION
3.	DATE COMPLETED DRILLER DRILLER DRILLER
٩.	DIAMETER: top 10 Inches Bottom 10 Inches TOTAL DEPTH 500 Feet
5.	CASING: Type Std Steel T&C Diameter 10 Inches Length 69 Feet
6.	SCREEN: Type Kome Opening Diameter Inches Length Feet
	Range in Depth { Top Feet Seologic Formation Feet Seologic Formation Feet Feet
	Tail piece: DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Minute at Feet above surface
	Water rises toFeet above surface
8	RECORD OF TEST: pare America 19, 1967 Yield 159 Gallons per minute Static water level before pumping 55
	Static water level before pumping
	Pumping level 172 feet below surface after hours pumping
	Drawdown 117 Feet Specific CapacityBals, per min. per ft, of drawdown
	Now Pusped Turbine pusp Now measured Orlflee
	Observed effect on nearby wells
•	PERMANENT PHAPTING SOUTHMENT.
۹.	PERMANENT PUMPING EQUIPMENT:
9.	Type Hfrs. Hame
٠.	Type Hfrs. Hame
9.	Type Hfrs. Hame H.P R.P.H B.P.H Bepth of Pump in well Feet Depth of Footplece in well Feet
9.	Capacity G.P.M. How Driven H.P. R.P.M. Depth of Pump in well Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Meter on Pump \$ize_Inches
9.	Capacity G.P.M. How Driven H.P. R.P.M. Depth of Pump in well Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Meter on Pump \$ize_Inches
	Capacity G.P.H. Now Driven H.P. R.P.H. Depth of Pump in well Feet Depth of Footplece in well Feet Depth of Air Line in well Feet Type of Heter on Pump Size inches USED FOR Deitstrial - R & A Lab. AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT AMOUNT
9. 10.	Type
	Type
11.	Capacity
11.	Capacity

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DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
DIVISION OF WATER POLICY & SUPPLY

Permit No. 26 - 4309
Application No. ______
County _____

•	OWNER COLD DIEWH, INC. ADDRESS 119 Long Avenue, Hillside, N.J.
	Owner's Well No SURFACE ELEVATION Feet
2.	LOCATION Hillside, Union
3.	DATE COMPLETED 2/13/70 DRILLER Somervilel Well Drilling Co.
٩.	DIAMETER: top 12 Inches Bottom 8 Inches TOTAL DEPTH 225 Feet
5.	CASING: Type Drive Diameter 8 Inches Length 98 Feet
6.	SCREEN: Type Size ofInchesFeet
	Range in Depth { Top Feet Geologic Formation
	Tail piece: DiameterInches LengthFeet
	WELL FLOWS NATURALLY Gallons per Minute at Feet above surface
	Water rises toFeet above surface
	RECORD OF TEST: Date 10/27/70 Yield 300 Gallons per minute
	Static water level before pumping 30 Feet below surface
	Pumping level 147 feet below surface after 5 hours pumping
	Brawdown 117 Feet Specific Capacity 2 Gals. per min. per ft. of drawdown
	Now Pumped C Mix submersible How measured Weir
	Observed effect on nearby wells
١.	PERMANENT PUMPING EQUIPMENT:
	Type Hfrs. Hame
	Capacity
	Depth of Pum. in well Feet Depth of Footpiece in well Feet
	Depth of Air Line in wellieet Type of Neter on Pump SizeInches
0.	USED FOR Gallons Daily AMOUNT Average Gallons Daily
۱.	QUALITY OF WATER good Sample: Yes No. X
	Taste Odor Color Clear Temp op
2.	(dive details on back of sheet or on experses sheet. If electric log vas made, electric furnish copy)
3.	SOURCE OF DATASomerville Well Drilling Co
4.	DATA OBTAINED BY Sene Date 2/24/70
	(NOTE: Use other side of this sheet for additional information such as log of materials ponetrate analysis of the water, shetch map, shotch of special casing arrangements etc.)

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26.22.427

FATE &2-4-4-49

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT Division of Water Policy & Supply WELL RECORD

1. OWNER Suprise Dairies ADDRESS State Highway 29, Hillside, N.J.
Owner's Well No
2 LOCATION Hillside, New Jersey
3. DATE COMPLETED 6/25/53 DRILLER Artesian Hell & Equipment Co., Inc.
8. DATE COMPLETED 6/25/73 DRILLER ACCORD
4. DIAMETER: Top. 10" Inches Bottom 10 Inches TOTAL DEPTH 630 Feet
5. CASING: Type Steel Diameter 10 Inches Length 112 Feet
Size of Inches LengthFeet 6. SCREEN: TypeOpeningDiameterInches
6. SCREEN: Type
Range in Depth Top Feet Geologic Formation Length Feet Inches
This page: Diameter
7. WELL FLOWS NATURALLY
7. WELL FLOWS NATURALLI
Water rises to
8. RECORD OF TEST: Date 4/52 Yield 258. Gallons per minute
Static water level before pumping 25 5 5 5 Feet below surface
Pumping level 147 feet below surface after 8 hours pumping
Pumping level 147 test below surface at our
Drawdown 121 7" Feet Specific Capacity
How Pumped Deep well turbine How measured Open orifice
Observed effect on nearby wells.
9. PERMANENT PUMPING EQUIPMENT: Type Deep well turbine Capacity 250 Gallons per minute
Type Deep well turbine Capacity
How Driven Electric
How Driven Electric
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Gallons Daily
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Gallons Daily Average Gallons Daily
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Gallons Daily AMOUNT Maximum Gallons Daily
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Gallons Daily AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER Exceedingly hard Sample: Yes. No.
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Gallons Daily 10. USED FOR AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER Exceedingly hard Sample: Yes No. Taste Odor Color Temperature
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Gallons Daily 10. USED FOR AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER Exceedingly hard Sample: Yes No. Taste Odor Color Temperature Are samples available?
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Feet 10. USED FOR AMOUNT AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER Exceedingly hard Sample: Yes No. Taste Odor Color Temperature Are samples available? 12. LOG See other side Are samples available? 13. SOURCE OF DATA Artesian Well & Equipment Co., Inc.
How Driven Electric Horse Power 30 R.P.M. 1750 Depth of pump in well 160 Feet Depth of foot piece in well Gallons Daily 10. USED FOR AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER Exceedingly hard Sample: Yes No. Taste Odor Color Temperature

Form 87-54-4-49

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT Division of Water Policy & Supply

Permit No. 26-//	7.	•
Application No	•	•
County		•

OWNER MYS. J. BRINK ADDRESS. J.I. JEFREAGON J. LIZ. OWNER'S Well No. ON SURFACE ELEVATION OF COMPLETED. DATE COMPLETED. DATE COMPLETED. DIAMETER: Top. Inches Bottom Inches TOTAL DEPTH IN Feet CASING: Type. Opening. Inches Inches Length. Size of Opening. Inches Length. Feet Size of Diameter. Inches Length. Feet Tail piece: Diameter. Inches J. Length. Water rises to Feet above surface Water rises to Feet above surface RECORD OF TEST: Date Feet Static water level before pumping. Pumping level. Feet Drawdown. Feet Specific Casacity. Observed effect on nearby wells. PERMANENT PUMPING EQUIPMENT: Type. Capacity. Gallons per minute How Driven. Depth of pound in well. Feet Depth of pound in well. Feet Taste. Odor Color Temperature. Are samples available. Are samples available. Are samples available.	WELL RECORD TE STEER SON ST. EL12.
Owner's Well No. LOCATION. DATE COMPLETED. DATE COMPLETED. DIAMETER: Top. DIAMETER: Top. Diameter. Diam	OWNER MYS. J. BRINK- ADDRESS 714 NEPPERS
DATE COMPLETED DATE COMPLETED DIAMETER: Top Diameter	SIRFACE ELEVATION
DATE COMPLETED. DIAMETER: Top	Charant IT- ELIZHBETH THE
DIAMETER: Top	TY TOULER T. A. D.
Diameter Diameter Length Feet Size of Opening Diameter Diameter Length Feet Range in Depth Bottom Feet Tail piece: Diameter Inches Water rises to Feet above surface RECORD OF TEST: Date Feet Static water level before pumping Drawdown Feet Specific Capacity Gallons per min. per ft. of drawdown Doserved effect on nearby wells. 9. PERMANENT PUMPING EQUIPMENT: Capacity Gallons per minute How Driven Depth of pump in well Feet Depth of foot piece in well Gallons Daily AMOUNT Maximum Gallons Daily Sample: Yes No. Taste Odor Color Temperature Preet Specific Color Temperature Are samples available.	Inches TOTAL DEPIR
Diameter Inches Length Range in Depth Top Feet Geblogs Formation Range in Depth Bottom Feet Tail piece: Diameter Inches Well Flows Naturally Gallons per Minute at Feet above surface Water rises to Gallons per minute RECORD OF TEST: Date Feet above surface Static water level before pumping feet below surface after hours pumping Drawdown Feet Specific Concists Gals per min. per ft. of drawdown How Pumped Feet Specific Concists Gals per min. per ft. of drawdown Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type Capacity Gallons per minute How Driven Depth of pump in well Feet Output Depth of pump in well Gallons Daily AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER. Color Temperature Feet Are samples availables	DIAMETER: Top
Range in Depth Bottom Feet Tail piece: Diameter Inche 7. WELL FLOWS NATURALLY Gallons per Minute at Feet above surface Water rises to Feet above surface 8. RECORD OF TEST: Date Feet Static water level before pumping Pumping level Feet Specific Capacity Gallons per minute How Pumped PLIPY CALLED How measured Gallons per minute 9. PERMANENT PUMPING EQUIPMENT: Type Capacity Gallons per minute How Driven How Driven Horse Power R.P.M. Depth of pump in well Feet 10. USED FOR MATER Gallons Daily AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER Color Temperature Odor Color Temperature Are samples availables	CASING: Type
Range in Depth Bottom Feet Tail piece: Diameter Inches 7. WELL FLOWS NATURALLY Gallons per Minute at Feet above surface Water rises to Feet above surface 8. RECORD OF TEST: Date Feet above surface Static water level before pumping feet below surface after hours pumping Pumping level Feet Specific Concists Gals per min. per ft. of drawdown How Pumped Feet On nearby wells How measured Gallons per minute 9. PERMANENT PUMPING EQUIPMENT: Type Gallons per minute Horse Power R.P.M. Depth of pump in well Feet 10. USED FOR MATER. Gallons Daily AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER. Color Temperature Are samples availables	SCREEN: Type Opening Diameter Geologic Formation
Tail piece: Diameter Nett Flows Naturally Gallons per Minute at Feet above surface Water rises to RECORD OF TEST: Date Static water level before pumping Pumping level Press below surface after Pumping level Drawdown How Pumped Piece Specific Capacity Observed effect on nearby wells Permanent Pumping Equipment: Type Capacity Gallons per minute Capacity Gallons per min. per ft. of drawdown How Driven How Driven Depth of pump in well Depth of pump in well Odor Color Temperature Feet Odor Color Temperature Are samples availables	Range in Depth Bottom Feet
Water rises to	Tail piece: Diameter
Static water level before pumping. Static water level before pumping. Pumping level. Feet Specific Concity. Gallo Der min. per ft. of drawdown How Pumped. Observed effect on nearby wells. 9. PERMANENT PUMPING EQUIPMENT: Type. Capacity. Gallons per minute Capacity. Gallons per minute Feet Horse Power. R.P.M. Peet Depth of pump in well. 10. USED FOR. AMOUNT AMOUNT Maximum. Gallons Daily Sample: Yes. No. Taste. Odor Color Temperature. Feet Are samples availables.	WELL FLOWS NATURALLY VV Gallons per Minus at
Static water level before pumping Static water level before pumping Pumping level Feet Specific Concity Galla per min. per ft. of drawdown How Pumped Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type Capacity Gallons per minute Horse Power R.P.M. Feet Depth of pump in well 10. USED FOR AMOUNT Maximum Gallons Daily AMOUNT Maximum Gallons Daily Sample: Yes No. Temperature Odor Are samples availables	Water rises to
Static water level before pumping Pumping level feet below surface after hours pumping Drawdown Feet Specific Capacity Gale per min. per ft. of drawdown How Pumped How Pumped How Pumping Equipment: 9. PERMANENT PUMPING EQUIPMENT: Type Capacity Gallons per minute How Driven Horse Power R.P.M. Depth of pump in well Gallons Daily 10. USED FOR MATER. Codor Color Temperature Are samples availables	
Drawdown How Pumped Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: How Driven Depth of pump in well 10. USED FOR AMOUNT Maximum Gallons Daily AMOUNT Maximum Gallons Daily Sample: Yes No. Taste Odor Color Temperature Are samples availables	Static water level before pumping
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Capacity Capacity Capacity Gallons per minute R.P.M. Horse Power Depth of pump in well OUN AMOUNT Maximum Gallons Daily Sample: Yes No. Color Temperature Odor Are samples availables	Pumping level feet below surface alter Gals, per min. per ft. of drawdown
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Capacity Capacity Gallons per minute R.P.M. Horse Power Depth of pump in well OUNT AMOUNT Maximum Gallons Daily AMOUNT Maximum Gallons Daily 11. QUALITY OF WATER. Odor Color Taste. Odor Are samples availables	Drawdown Feet Specific Capacity 3 1 1 C
Type	
Type	Observed effect on nearby wells
How Driven Horse Power Depth of pump in well Out Average AMOUNT Maximum Gallons Daily Sample: Yes No. Color Taste Odor Are samples available?	9 PERMANENT PUMPING Decilors per minute
Depth of pump in well. 10. USED FOR. 11. QUALITY OF WATER. Odor Color Color Taste. Odor Odor Odor Are samples available?	Type R.P.M
Depth of pump in well 10. USED FOR	The Parison
10. USED FOR	Depth of pump in well. Gallons Daily
11. QUALITY OF WATER. Color Temperature. Are samples available.	10. USED FOR Callons Daily
11. QUALITY OF WATER. Color Temperature. Are samples available.	(Maximum
Taste	Sample. 14.
	Color Color
18. SOURCE OF DATA OUT FILES	10 SOURCE OF DATA OUT FILES
DATE	18. SOURCE DATE
14. DATA OBTAINED BY . O V V V V V V V V V V V V V V V V V V	the other side of this sheet for additional information such as log of materials

Ports 87-54

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT Division of Water Policy & Supply WELL RECORD

Permit No.	26-562
Application	n No
County	

	OWNER	ADDRESS	?) ~ox ∴lizab	eth, .	.T.	
1.	OWNER	_ ~~~	ELEVATION			Peet
	Owner's Well No2					
2.	LOCATION	ersey	Chathage (inc.		
3.	DATE COMPLETED YOU 10, 1952 DRIE	LER	SESENSIT		400	
4.	DIAMETER: Top 8 Inches Bottom	8Inches	TO	TAL DEF	TH 400	
5.	CASING: Typedri:e p:pe	_ Diameter	8 Inches	Length	2817"	Feet
	Size of SCREEN: TypeOpening	_ Diameter	Inches	Length .		Feet
	(Top Feet	Geologic	Formation			
	Range in Depth { Top Feet Bottom Feet					
	Tail piece. Diameter Inches	Length	Feet			
7.	WELL FLOWS NATURALLY Gallons	per Minute a	it		_Feet above	surface
	Water rises to	feet above sur	face			
8.	RECORD OF TEST: Date Nov. 8, 1952	Yield _	. 24		Gallons per	minute
••	manda lamal badama muming	15			Leer Derom	BULIECE
••	Static water level before pumping	below surface	after	1	pours	pumping
••	Static water level before pumping	below surface	after	per min.	hours	pumping rawdown
-,	Static water level before pumping	below surface c Capacity	afterGals.	per min.	hours	pumping rawdown
•	Static water level before pumping	below surface c Capacity	afterGals.	per min.	hours	pumping rawdown
	Static water level before pumping	below surface c Capacity How mea	afterGals.	per min. 55 ga	hours per ft. of d	pumping rawdown
	Static water level before pumping	below surface c Capacity How nea	gals. Gals. Capacity	per min. 55 ga	hours per ft. of d l bblGallons per	pumping rawdown
	Static water level before pumping	below surface c Capacity How mea	Gals. Gals. Gals. Capacity Horse Power	per min. 55 %a.	hours per ft. of d bbl Gallons per	pumping rawdown
	Static water level before pumping	below surface c Capacity How nea How nea	Gals. Capacity Horse Power	per min. 55 ga	hours per ft. of d bbl Gallons per	pumping rawdown minute
9.	Static water level before pumping Pumping level	below surface to Capacity	Capacity ————————————————————————————————————	per min55 gs.	hours per ft. of d bbl Gallons per	pumping rawdown minute
9.	Static water level before pumping Pumping level	below surface to Capacity	Capacity ————————————————————————————————————	per min55 gs.	hours per ft. of d bbl Gallons per	pumping rawdown minute
9.	Static water level before pumping	below surface to Capacity	Capacity ————————————————————————————————————	per min55 gs.	hours per ft. of d l bbl Gallons per R.P.M	pumping pumping rawdown minute
9.	Static water level before pumping Pumping level	below surface to Capacity How mea	Capacity Horse Power Poot piece in water on Pump Average	per min55 gs.	hours per ft. of d l bbl Gallons per R.P.M Gallo	pumping pumping rawdown minuteFeet
9.	Static water level before pumping Pumping level	below surface to Capacity How mea	Capacity Horse Power Poot piece in water on Pump Average	per min55 gs.	hours per ft. of d l bbl Gallons per R.P.M Gallo	pumping pumping rawdown minuteFeet
9.	Static water level before pumping	below surface c Capacity How sea none Depth of F Type of Me AMOUNT	Capacity Horse Power Poot piece in wester on Pump Average Maximum Sample: Yes	per min. 55 gs.	hours per ft. of d 1 bbl Gallons per R.P.M Gallo	pumping pumping rawdown minute Feet as Dail;
9.	Static water level before pumping	below surface c Capacity How sea none Depth of F Type of Me AMOUNT	Capacity Horse Power Poot piece in wester on Pump Average Maximum Sample: Yes	per min. 55 gs.	hours per ft. of d 1 bbl Gallons per R.P.M Gallo	pumping pumping rawdown minute Feet as Dail;
9. 10. 11 12	Static water level before pumping Pumping level	Depth of F Type of Me AMOUNT Color	Capacity Horse Power Poot piece in wester on Pump Average Maximum Sample: Yes	per min. 55 gs.	hours per ft. of d 1 bbl Gallons per R.P.M Gallo	pumping pumping rawdown minute Feet as Dail;

(Woter the other side of this sheet for additional information such as log of materials penetrated, analysis of the vater, shotch map, shotch of special easing arrangements, etc.)

Form 87-54

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT Division of Water Policy & Supply WELL RECORD

26.21.9.6.4
Permit No. 26-1154
Application No
County

	OWNER Lampert Dairy Farms	ADDRESS 1600 East St. Goorge .ve. Linder
	Owner's Well No. 2	SURFACE ELEVATION Peet Peet
2.	LOCATION Above Address	David Wall & Dump Company
3.	DATE COMPLETED 4 - 7 - 55 DRILL	ER Parkhurst Well & Pump Company
4.	DIAMETER: Top 8 Inches Bottom 6	Inches TOTAL DEPTH 203 Feet 123
5.		Inches 6" TOTAL DEPTH 263 Feet 123' Diameter 8 Inches Length 11 Feet
6.	SCREEN: Type None Opening	DiameterInches LengthFeet
	Range in Depth Top Feet	Geologic Pormation
	Tail piece. Diameter Inches	Length reet
7.	WELL FLOWS NATURALLY NO Gallons	per Minute at Feet above surface
	Water rises toFe	et above surface
8.	RECORD OF TEST: Date 4 - 9 - 55	YieldGallons per minute
	at the makes level before numning	9 Feet below surface
	210 feet M	low surface after 6 hours pumping
	Drawdown 201 Feet Specific	Capacity 14 Gals. per min. per it. of drawdown
	How Pumped Cylinder Pump	How measured Barrell
		None
9.	Observed effect on nearby wells	
9.	Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT:	Capacity 30 Gallons per minute
9.	PERMANENT PUMPING EQUIPMENT: Type	Capacity Gallons per minute
9.	Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type	Capacity 30 Gallons per minute Horse Power 6 R.P.M. 3450 Depth of Foot piece in well 242 Feet
	Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: Typesubmersible How DrivenElectricmotor Depth of pump in well242 Feet Depth of Air Line in well242 Feet	Capacity 30 Gallons per minute
	Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: TypeSubmersible How DrivenBlectric Depth of pump in wellFeet Depth of Air Line in wellFeet USED_FORDairy	Capacity 30 Gallons per minute
	Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT: TypeSubmersible How DrivenBlectric Depth of pump in wellFeet Depth of Air Line in wellFeet USED_FORDairy	Capacity 30 Gallons per minute
10.	PERMANENT PUMPING EQUIPMENT: Typesubmersible How DrivenElectricmotor Depth of pump in well242 Feet Depth of Air Line in well242 Feet USED FORDairy	Capacity 30 Gallons per minute
10.	PERMANENT PUMPING EQUIPMENT: Typesubmersible How DrivenElectricmotor Depth of pump in well242 Feet Depth of Air Line in well242 Feet USED FORDairy OUALITY OF WATER	Capacity 30 Gallons per minute
10.	PERMANENT PUMPING EQUIPMENT: Typesubmersible How DrivenElectricmotor Depth of pump in well242 Feet Depth of Air Line in well242 Feet USED FORDairy QUALITY OF WATER	Capacity 30 Gallons per minute
10. 11. 12.	PERMANENT PUMPING EQUIPMENT: Type	Capacity 30 Gallons per minute

(Note: Now other side of this shoot for additional information such as log of materials penetrated, water, simtch map, simtch of special casing arrangements, etc.)

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

26-21-964 1 Permit No. 26 4045 Application No. _ County_

	OWNER Lamport Dairy Farms, Inc. Address 1600 St. George Ave., Linden, N. J.
i .	OWNER Feet Owner's Well No Feet
2.	LOCATION RDOVO
3.	DATE COMPLETED 1/18/67 DRILLER Frank Bott, Inc.
	O teston 6 Inches o TUTAL DEPTH 23
5.	CASING: Type steel Diameter 6 Inches Length 52 Feet
6.	Size of Diameter Inches Length
	Range in Depth { Top Feet Geologic Formation Feet Bottom Feet
	Inches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Minute at Feet above services
	Faat above surface
	Yield Yield Ballons per minute
•	level before availag bailer test 21 Feet beion st.
	feet below surface afterRours pumping
	Feet Specific CapacityGals. per min. per Tt. of Grandown
	Now measured
	Observed effect on nearby wells
	PERMANENT PUMPING EQUIPMENT: not yet installed
١.	M frs. Name
	A.P. M. Now Driven N.P R.F. M.
	Feet Death of Footpiece in well
	Feet Type of Neter on Pump 5126INCHES
	AverageGallons Daily
10	
	QUALITY OF WATER Sample: Yes No
11	QUALITY OF WATER Of or Color Temp of
	Taste Odor Are samples available?
11	Taste Are samples available? [Give details on back of sheet or on separate sheet. If electric log vac made, electric formich copy)
1	3. SOURCE OF DATA
106	4. DATA OSTAINED BY Frank J. Bott Date 1/20/67
A SHARE LANGE	(MOTE: Use other side of this sheet for additional information such as log of materials ponetrated analysis of the water, shotch map, shotch of special casing arrangements ste.)

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

Permit No	SC.	2972
Application	Na _	
County		

	OWNER Stanthamo Bill full address 1th and Center 20 Owner's Well No. Surface ELEVATION (Above som server) LOCATION Slig related Menry Jensy DATE COMPLETED 7.5.66 DRILLER Pite Chafitelli
	Owner's Well No SURFACE ELEVATION Feet
2.	LOCATION _ Elis relieth Wesser 1 2004.
3.	DATE COMPLETED 7 6 6 DRILLER B. Z. Chalitalli
٠.	DIAMETER: TOP 1 Inches Bottom Co Inches TOTAL DEDTU
5.	CASING: Type Mel W I north Diameter 6 Inches Length 22 Feet
6.	SCREEN: Type Size of Opening Diameter Inches Length Feet
	Range in Depth { Top 22 Feet Geologic Formation Stroke sound styn
	Tail piece: DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Minute at
	Water rises to / f' Feet shows and for
8.	RECORD OF TEST: Date 9-5-66 Yield / S Gallans and significant
	Static water level before pumping
	Pusping level 60 feet below surface after 60
	Drawdown 6 Feet Specific Capacity & Role made
	How Pumped Bailer Now measured dry
	Observed effect on nearby wells
_	
9.	PERMANENT PUMPING EQUIPMENT:
9.	PERMANENT PUMPING EQUIPMENT:
9.	Type Sentencilly Hers. Hame Myers Capacity 1 H G.P.H. How Driven Mer. H.P. 3/1/2 . R. H. 3/1/2
9.	PERMANENT PUMPING EQUIPMENT: Type Sections: White Mane Mages Capacity / H G.P.M. How Driven Mer. H.P. 3/4 R.P.M. 3600 Depth of Pump in well 80 Feet Depth of Footpiece in well
9.	PERMANENT PUMPING EQUIPMENT: Type Sections: White Mane Mages Capacity / H G.P.M. How Driven Mer. H.P. 3/4 R.P.M. 3600 Depth of Pump in well 80 Feet Depth of Footpiece in well
0.	PERMANENT PUMPING EQUIPMENT: Type Sentencial Mfrs. Name Magena Capacity 1 1 C.P.M. Now Driven Mer. N.P. 3/4 R.P.M. 3600 Depth of Pump in well 80 Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Neter on Pump Size Kinches
	PERMANENT PUMPING EQUIPMENT: Type Sentimes Wife. Mane Myona Capacity 14 6.P.M. How Driven Mer. H.P. 3/4 R.P.M. 3600 Depth of Pump in well 80 Feet Depth of Footpiece in well Feet Depth of Air Line in well Feet Type of Neter on Pump Size Cinches USED FOR America AMOUNT Average 200 Gallons Daily QUALITY OF WATER 10 rock
0.	PERMANENT PUMPING EQUIPMENT: Type Sections: War Mers. Name Mayora Capacity / H
0.	PERMANENT PUMPING EQUIPMENT: Type Sentimically
0.	PERMANENT PUMPING EQUIPMENT: Type Seafornsille Hfrs. Name Magena Capacity H G.P.M. How Driven Lee. N.P. 3/4 R.P.M. 3600 Depth of Pump in well & Feet Depth of Footplece in well Feet Depth of Air Line in well Feet Type of Neter on Pump Size Linches USED FOR Amenatic AMOUNT AMOUNT Waxinum 2.00 Gallons Daily QUALITY OF WATER A Good Color Color Temp. Taste Odor Color Color Temp. Of (Give details on back of shoot or an apparate sheet. If electric log was made, please SOURCE OF DATA
0.	PERMANENT PUMPING EQUIPMENT: Type Sealonsille

38W 87

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

26.21.6270 .
Permit No. 26-174
Permit No. 26-174
County

	Owner Suburban Golf Club ADDRESS MOFFIE Ave. Onton, 18:00
••	Owner's Well No. 1 SURFACE ELEVATION (Above sean sea level)
2.	LOCATION Norris Ave. Union, N.J.
3.	DATE COMPLETED
	DIAMETER: ton 12 Inches Botton 12 Inches TOTAL DEPTH 500 Feet
5.	CASING: Type drive pipe Diameter 12 Inches Length 26'4"Feet
6.	SCREEN: Type Diameter Inches LengthFeet
	SCREEN: TypeOpeningDiameterInches Length Range { Top Feet Geologic FormationShele Bottom Feet Bott
	Tail piece, DiageterInches LengthFeet
7	WELL FLOWS NATURALLY Gallons per Minste at Feet above surface
••	Feet above surface
8.	April 3/58 Yield 250 Gallons per minute
٥.	Static water level before pumping: 2916# Feet below surface
	Pumping level 1911 feet below surface after 8 hours pumping
	Drawdown 161'6" Feet Specific Capacity Gals. per min. per ft. of drawdown
	Drawdown 101.0 Feet Specific Capacity Orifice
	Now Pumped turbine Now measured orifice
	Observed effect on nearby wells
9.	PERMANENT PUMPING EQUIPMENT:
	Type Mfrs. Name
	Canadity R.P.H. Now Driven N.P R.P.H
	Death of Pump in wellFeetDeath of Footpiece in wellFeet
	Depth of Air Line in wellFeetDepth of Meter on Pump
10.	AMOUNT Average Gallons Daily
	Maximum Gallons Daily
11.	OUALITY OF WATERSample: Yes NoX_
	none der none color clear Teap.
[12.	And applied available no
. 13.	SOURCE OF DATA Well Statement.
14	DATA OBTAINED BY H.J Stothoff Date April 41958
k Le	(NOTE: Use other side of this sheet for additional information such as log of materials penetrated,

FORM 87.

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

26	21-64?	
	Persit No	76255
	Application	ia
	County	

	ADDRESS 554 Golf Ferrage, Union, Nava.
i. OWNER Manuel Rees	ADDRESS 554 Golf Ferrage, Union, No.J.
Auger's Well No	(Above seam see see
2. LOCATION 554 Golf Terrace, Union, N. 3. DATE COMPLETED _ 2/12/62 DRIV	LLER SOMERSET WELL & PIMP CO., INC.
3. DATE COMPLETED _2/12/62	Inches TOTAL DEPTHFeet
4. DIAMETER: top6Inches Bottom	Inches TOTAL DEFINFeet DiameterInches LengthFeet
5. CASING: Type Drive	Inches LengthFeet
0000100	y tom
TopFeet	Geologic Formation
Range in Depth { Bottom Feet	East
Rallons per	Winers or
7. WELL FLOWS NATURALLY Feet	above surface
Water rises to	yield 10 ≠ Gallons per minute Feet below surface
8. RECORD OF TEST: Date	Feet below surface
Static water level before pumping	Feet below surface hours pumping
Pumping level 80 feet below	surface after 5 hours pumping Capacity 2 Gals. per min. per ft. of drawdown How measured backet.
Brawdown 60 Feet Specific	Capacity
	How metales
	How metales
Observed effect on nearby wells	none.
Observed effect on nearby wells PERMANENT PUMPING EQUIPMENT:	none.
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type	frs. Name
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type K Capacity G.P.M. Now 1	Driven N.P R.P.M Feet
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type K Capacity G.P.M. Now 1	Depth of Footpiece in well SizeInches
Observed effect on nearby wells	Depth of Footpiece in well SizeInches
Observed effect on nearby wells	Depth of Footpiece in well SizeInches
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type K Capacity G.P.M. Now 1	Depth of Footpiece in well Sizeinches
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type	None
Depth of Air Line in well Feet 10. USED FOR RATER Odes Depth of WATER P. No Feet Feet Feet Feet Feet	
Depth of Air Line in well Feet 10. USED FOR RATER Odes Depth of WATER P. No Feet Feet Feet Feet Feet	
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type Capacity Depth of Pump in well Depth of Air Line in well 10. USED FOR Taste Quality OF WATER Taste Quality Of WATER (Green left line in book of shock or of capacity) (Green left line in book of shock or of capacity)	Driven N.P R.P.M Depth of Footpiece in well Feet Type of Heter on Pump SizeInches AMOUNT { Average 200 Gallons Daily Maximum 500 Gallons Daily Sample: Yes Ho Color clear Temp 561 or Are samples available? yes
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type Capacity Depth of Pump in well Depth of Air Line in well 10. USED FOR Taste Quality OF WATER Taste Quality Of WATER (Green left line in book of shock or of capacity) (Green left line in book of shock or of capacity)	Driven N.P R.P.M Depth of Footpiece in well Feet Type of Heter on Pump Sizeinches AMOUNT { Average 200 Gallons Daily Haximum 500 Gallons Daily Sample: Yes Ho Color clear Temp 561 or separate sheet. If electric led was nade, vicase.
Observed effect on nearby wells 9. PERMANENT PUMPING EQUIPMENT: Type Capacity G.P.H. Now Depth of Pump in well Depth of Air Line in well Feet 10. USED FOR Taste Oak (Give details on beef of sheet or of furnish copy) 13. SOURCE OF DATA STATEST WELL & F.	Type of Neter on Pump Sizeinches AMOUNT { Average 200
Deserved effect on nearby wells PERMANENT PUMPING EQUIPMENT: Type Capacity G.P.M. Now Depth of Pump in well Depth of Air Line in well Feet 10. USED FOR Taste Oak Oder (Give details on beef of sheet or of furnish copy) 13. SOURCE OF DATA STATEST WELL A.	Type of Meter on Pump Sizeinches AMOUNT { Average 200

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

26.	. 3	3/-	37	12
Pormit No. S	26	10	96	2
Application				
county				

	ER Smith&Kangler Co ADDRESS SURFACE ELEVATION	East.
. OWNER	ER Smith&Kangler Co. ADURESS ADURESS SURFACE ELEVATION	(Above mean sea level)
Owner	er's Well No	•
LOCAT	ATIONUnimm County.Lindon.N.J.	111
DATE	E COMPLETED 5/8/65 DRILLER Peta Chafita	TAL DEPTH 360 Feet
. DATE	E COMPLETED	teach 27 Feet
DIAME	METER: top 8 Inches Bottom Inches SING: Type steel drive-pipe Diameter 8 Inc	hes Length
s. SCREE	REEN: TypeFeet	
Ranc	ange in Depth {	
Tal	all piece: Diameterinches Length LL FLOWS NATURALLY Gallons per Minute at	Feet above surface
- WELL	IL FLOWS HATURALLY Bellons per Him	
w	ter rises to	es sallons per minute
. RECO	ECORD OF TEST: Date	8 Feet below surface
Sta	Static water level bafore pumping	hours pumping
Put	Static water level bafore pumping	le per min. per ft. of drawdown
	Pumping level 258 150 feet below surface after	. eiveline
	turbine numb	01
Xov	Observed effect on nearby wells Ro Hade	
0 b	Observed error on House Follipment:	
9. PE	PERMANENT PUMPING EQUIPMENT: Type submersible turbine Hfrs. Name Dam	ing Prosp
T	Type submersible turbine Hfrs. Hame	H.P. 71 R.P.H.3500
C	Depth of Pump in well 255 Feet Depth of Footpiece	in well Feet
1	pepth of Pump in well 200 Feet Depth of Mater on	Pump Sizeinches
1	Depth of Pump in well 255 Feet Depth of Footpless Depth of Air Line in well mempeet Type of Meter on	Gallons Daily xinum Gallons Daily
	USED FOR Industrial AMOUNT	Gallons Daily
10.	USED FOR INGUISE	X 1845
	QUALITY OF WATER good Sa	nple: Yes No
11.	QUALITY OF WATER Color	Temp
	LOG O1-271 eley. 27-360 Tr. shale	Are samples available?
12.	LOG O'-27° elay. 27-369 Trashale (Give details on back of shoot or on separate sheet. If	
	course of DATA drill euttings	
13.		Date 5/10/65
14.	(NOTE: Use other side of this sheet for additional informational resistance of the vator, statch map, sketch of special casing	les such as log of materials penetral
	and at this short for annial sasial	attem famour.

DEPARTMENT OF CONSERVATION

AND ECONOMIC DEVELOPMENT

DIVISION OF WATER POLICY & SUPPLY

Permit No. 26_2389
Application No. _____

	OWNER C.O. Pellosiposer, Inc. ADDRESS 501 W. Brinkway, la leusin N.O.
١.	OWNER C.O. / 6 // 03/9 J.T. ADDRESS
	Owner's Well No Surrow (Above seen see level)
2.	DIAMETER: top 6" Inches Bottom Inches Total DEPTH 14" Foot
3.	DATE COMPLETED TELECH DRILLER TO DRILLER
٩.	DIAMETER: top 6 Inches Bottom Inches 101AL DEPTH 144' 5001
	Diameter O Inches Length
6.	SCREEN: Type Size of Diameter Inches LengthFeet
	Range in Depth { Top Feet Geologic Formation Sand Sand Feet Geologic Formation Sand Sand
	Tail piece: DiameterInches LengthFeet
7.	WELL FLOWS NATURALLY Gallons per Minute at Feet above survey
	Water rises toFeet above surface 7 Gallons per minute
8.	RECORD OF TEST: Date March 20, 196) Static water level before pumping
	Static water level before pumping
	Pumping level 25 feet below surface afterhours pumping
	Pumping level 25 feet below surface after 4 hours pumping Prawdown 24 Feet Specific Capacity Gals. per min. per ft. of drawdown O To To To Gas former supping
	How Pumped Contractors Gas Tamp How measured 37271
	How Pumped Contraction Gas Pump How measured Squal Pail Observed effect on nearby wells Note
9.	PERMANENT PUMPING EQUIPMENT:
	Type Shallow Well Jet Hers. Home Barnes
	Type Shallow Well Jet Hers. Hame Barnes Capacity G.P.N. How Driven H.P. 1/3 R.P.N
	Feet Depth of Footpiece in Well
	Size_Inches
	AverageGallons Daily
10.	USED FOR Howse Lold AMOUNT AMOUNT Average Gallons Daily
11	QUALITY OF WATER Good Sample: Yes No
	Taste Get Odor None Color C/the Temp
12	(Olive details on back of sheet or on separate sheet. If electric log was made, please
13	Source of DATA Makey Brothers
13	Date May 11, 1961
	(NOTE: Use other side of this sheet for additional information such as log of materials penetrates

.....

DEPARTMENT OF ENVIRONMENTAL PROTECTION

26.2	1.616	
OTECTION	Permit (026-4814)	
	County	

. OWNER L Industries ADDRESS 1080 Garden State Road, Union,	N.J. 083
Owner's Well No SURFACE ELEVATION (Above non see ferel)	• t
Lot 16, Block 50-2, Union, Union County, New Jersey	
DATE COMPLETED	
OTANCIER. COP	
. CASING: Type Steel pipe Diameter 6 Inches Length 91 Fe) C
Size of DiameterInches LengthFe	• t
Range in Depth { Top Feet Seologic Formation Seologic Fo	_
Tail piece: DiameterInches LengthFeet	
. WELL FLOWS NATURALLY Gallons per Minute at Feet above surf	460
Water rises teFeet above surface	
. RECORD OF TEST: Date 11/1/79 Yield 300 Gallons per min	u to
Static water level before pumping	400
Pumping levelhours pump	ing
BrawdownFeet Specific CapacityGals. per min. per ft. of draw	down
How Pumped Now measured 5 gal. pail	
Observed effect on nearby wellsNone	
. PERMANENT PUMPING EQUIPMENT:	
Type W/A Hfrs. Hame	
Capacity	
Sopth of Pump in well Feet Depth of Footpiece in well	_ Feet
Septh of Air Line in wellFeet Type of Heter on Pump Size	
(AverageGallons B	aily
O. USED FOR Gallons B MOUNT { Average Gallons B Maximum Gallons B	ally
11. QUALITY OF WATER Dakages No. X	
Taste Oder Color Temp	°F
2. LOG 0-85' sand & gravel, 85'-300' shale (Give details on bock of sheet or on apparate sheet. If electric log one mode, electric log o	
3. SOURCE OF DATA Wm. Stothoff Co., Inc.	
14. DATA OBTAINED BY H H H H Bate 1/9/80	
(NOTE: Use other side of this sheet for additional information such as led of meterials pe analysis of the water, sheeth map, sheeth of special casing arrangements etc.)	ه د د.

FORM \$7- 104

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF WATER POLICY & SUPPLY

Permit No	26	3-1979
Application		
County		

Anness 18 Donaldson Pl.	
Owner's Well No ADDRESS 18 Donaldson Pl. SURFACE ELEVATION (Above mean sea level)	t
Owner's Well No	
LOCATION Linden, N.J. P. Chafitelli	_
Location Linden, N.J. DATE COMPLETED 3/31/59 DRILLER P. Chafitelli DATE COMPLETED 8 Inches TOTAL DEPTH 550 Fee	•
DATE COMPLETED 3/31/59 DRILLER F. OHATTOO TOTAL DEPTH 550 Fee DIAMETER: top 8 Inches Botton 8 Inches Length 40 Fee	
DIAMETER: top 8 Inches Botton 8 Inches 101AL DET III	
TESEL CLIVE P.	
CASING: Type	_
TopFeet Geologic Formation	
Range Bottom Feet	•
Tail piece. DiameterInches LengthFeet above surfa	c •
Tail piece. Diameterinches LengthFeet above surface. 7. WELL FLOWS NATURALLY Gallons per Minute atFeet above surface.	
7. WELL FLOWS MATURALLYFeet above surface Water rises toFeet above surface 70Gallons per minutes	
Water rises toFeet above surface 70	
	4 C C
Static water level before pumping 8hours pump	ing
Pumping levelfeet below survace and gala, per min. per ft. of draw	down
Pumping level 110 feet below surface after	
. Air lift	
Now Pumped	
Deming	
9. PERMANENT PUMPING EQUIPMENT: Type	3600
Type vert. turbine Hfrs. Hame Desired H.P. 10 R.P.H. Capacity 65 G.P.H. How Driven Bled. H.P. 10 R.P.H. Capacity 65 G.P.H. Depth of Footpiece in well 10	5000
Capacity 65 G.P.M. How Driven Block No. 10 Depth of Pump in well 200 FeetDepth of Footpiece in well 10	
Depth of Pump in well Peet Depth of Neter on Pump Gallons	
Depth of Air Line in wellFeetBepth of Actions 10. USED FOR	Daily
10. USED FOR Gallons	Daily
No	_
OUALITY OF WATER GOOD SAME	°F
None Oder None Color Land	No.
Taste None Odor None Color Class 12. LOG O-30' clay, sd. & clay, 30' to 55' shalqre camples available	
(dive details on our diversity of the details of th	
13. SOURCE OF DATA Bailer dumpings Date April 7,	1959
D 41100	
DATA ORTAINED BY Driller	penetrat.
(NOTE: Use other side of this shoot for additional information such as log of materials analysis of the vator, sketch map, sketch of special cooling arrangements etc.)	penetrat

- cou 87 .

DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES

Permit No	26-4449
Application	
County	

1.	OWNER Dog License Bureau, c/o Fiblidatoress Works Dept. 302 S. Wood Ave., Linden New Jersey 07036 (Above seen see level)
2.	LOCATION Range Road, Linden, N.J.
3.	DATE COMPLETED 4/28/72 DRILLER Somerville Well Drilling Co., Inc.
٩.	DIAMETER: top 10 Inches Bottom 6 Inches TOTAL DEPTH 460 Feet
5.	CASING: Type Drawe Dlameter 6_ Inches Length 56_ Feet
6.	SCREEN: Type Size of Diameter Inches LengthFeet
	Range in Depth { Top Feet Beologic Formation Feet Bottom Feet
	lockee LengthFeet
_	WELL FLOWS NATURALLY Ballons per Minute at Feet above better
7.	FAAL ANNUA RUFTECE
	6/26/72 Yield 20
8.	7
	and below explore after
	Pumping level 300 feet Below Survices Control of Grandown Brawdown 293 Feet Specific Capacity 2 Gals. per min. per ft. of drawdown
	Non Beganied
	Non Beganied
	Now Pumped Now measured
	Now Pumped Now measured
	Now Pumped Now measured
•	Observed effect on nearby wells None PERMANENT PUMPING EQUIPMENT: Type Nfrs. Name N.P R.P.N
•	Now Pumped Now measures
•	Now Pumped Now measures
•	Now Pumped Now measures
•	Observed effect on nearby wells
	Observed effect on nearby wells
	New Reasures
1	Now Pumped
1	Observed effect on nearby wells
1	Observed effect on nearby wells

REFERENCE NO. 20

CDM Federal Programs Corporation

RECORD OF COMMUNICATION

SUBJECT: C. ty of PARTICIPANTS	OUTGOING TIME: 454 RECORDED BY: _ EPA CONTRACT NO E(izabeth Popu	Pat Tom 7258024 Lation Cencu	· S
Pat Tom	CityHaliof Elizabeth - CDMJFPC	353-	
To get a the commun	eorded as 11 more specific to ity Development e contacted.	o voc peo opulation	locality
DISTRIBUTION: OTHER:	PARTICIPANTS FILE	INFORMATION	ACTION

REFERENCE NO. 21



CITY OF ELIZABETH, NEW JERSEY

DEPARTMENT OF PUBLIC WORKS OFFICE OF THE CITY ENGINEER

City Engir

THOMAS G. DUNN

neer	Mayor
	Date: June 1, 1992 Certificate No. E-1285 C
To CDM Federal Program Corp.	-
111 Fulton St. Suite 710	<u>.</u>
New York, NY 10038	-
Re: Address:	714 Division St.
Acct. No:	8-428D
Owner:	R. & F. Gentempo
Dear Sir or Madam:	1
Pursuant to your request of June advised that a review of Firm-Flood Federal Emergency Management Agency 345523 E, revised November 1, 1985, above captioned premises are within C- AREAS OF MINIMAL FLOODING	d Insurance Rate Map, y, Community Number , indicates that the

EJM/ nms Regular Program **REFERENCE NO. 22**



UNION COUNTY

404106074171901. Local I.D., Union County Park Obs. NJ-WRD Well Number, 39-0119.
LOCATION.--Lat 48-41-06-7 Long 74-17-19-, Hydrologic Unit 02030104, at Galloping Hill Golf Course, Kenilworth.

Quiner: Union County Park Commission.

AQUIFER.--Passaic Formation of Jurassic-Triassic age.

WELL CHARACTERISTICS.--Drilled artesian observation well, diameter 6 in, length of casing unknown, depth 290 ft, green hole.

open hole.
INSTRUMENTATION.--Digital water-level recorder--60-minute punch.
INSTRUMENTATION.--Digital water-level recorder--60-minute punch.
INSTRUMENTATION.--Digital water-level recorder--60-minute punch.

DATUM.--Land-surface datum is 69.00 ft above National Geodetic Vertical Datum of 1929.

Measuring point: Top edge of recorder shelf, 2.30 ft above land-surface datum.

Measuring point: Top edge of recorder shelf, 2.30 ft above land-surface datum.

REMARKS.--Water level affected by nearby pumping.

REMARKS.--Water level affected by nearby pumping.

REMORES.--Water level affected by nearby pumping.

April 1984. Records for 1975 to 1983 are unpublished and are available in files of New Jersey District Office.

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April 1984. Records for 1975 to 1983 are unpublished and are available in files of New Jersey District Office.

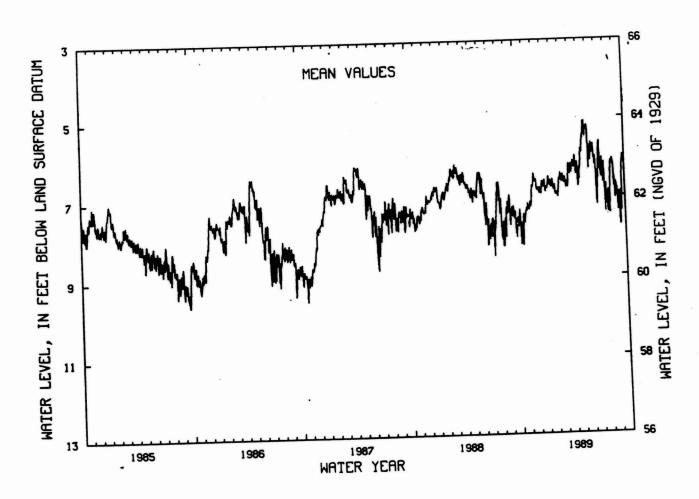
April 1984. Records for 1975 to 1983 are unpublished and are available in files of New Jersey District Office.

April 1984. Records for 1985 to 1985 are unpublished and are available in files of New Jersey

WATER LEVEL, IN FEET BELOW LAND SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

					MEA	N VALUES						
244	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY					. —		4 70	6 25	5.05	6.32	7.41	6.79
5	7.62	7.27	6.57	6.82	6.73	2.43	6.11	5.85	5.95 5.74 5.71	6.24	7.41 7.43 6.24 6.05	6.79 6.89 7.15
10	7.31	7.28	6.87	6.53	6.94	6.62	6.23	5.53	5.71	6.52	6.05	6.61
20	8.22	6.95	6.83	6.63	6.78	6.61	6.43	5.11	6.04	6.32 6.24 6.52 6.65 6.76 7.11	6.48	6.61 5.99 6.42
10 15 20 25 EON	7.62 7.31 7.75 8.22 7.53 7.35	7.27 7.28 7.21 6.95 6.66 6.54	6.57 6.81 6.87 6.83 6.60 6.72	6.53 6.63 6.75 6.60	6.73 6.94 6.94 6.78 6.52 6.54	6.45 6.64 6.62 6.61 6.27 6.32	6.39 6.11 6.23 6.43 6.21 6.30	6.25 5.85 5.53 5.11 5.29 5.39	5.99	7.11	6.66	6.42
EOM	7.35	6.54	6.72	0.00	0.54				4.04	6.41	6.69	6.79
MEAN	7.67	7.03	6.74	6.67	6.76	6.54	6.26	5.58	6.04	0.41	0.07	••••
UTD YE	1989	EAN 6.60	HIGH 5.0	1 MAY 18	LOW 8.6	7 OCT 20						

NJ-WRD WELL NO.39-0119



THE YES SEEN

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NJ-WRD WELL WUMBER	SITE	LOCAL IDENTIFIER	LATITUDE	LONGITUDE	AQUIFER UNIT	VC	PERIOD OF RECORD
					χ(1'·		4044 4004
01-387	RAMBERG, RALPH US GEOL SURVEY	AMATOL 8 USGS 4-H-2	393557	744114	121CKXD -	, v .	1961-1986 1963-1986
01-496 -01-542	US GEOL SURVEY	WHARTON 2G	394029 394028	744000 # Ja	121CKX	ំតម្ភាហ្វី។ វប្រ	1060-1086 · 8
01-545	US GEOL SURVEY	WHARTON 11	394058	744022	121CKK	1 0 9 3K	1957-1986
21-775	ATLANTIC CITY MUA	FAA INTERMED	392639	743232	121CKKD		1985-P
01-776 05-029	ATLANTIC CITY MUA	FAA SHALLOW	392639	743232	121CKO 121CKO 121CKO 121CKO		1985-P
05-029	US GEOL SURVEY	OSWEGO LAKE 1	394208		121CKRD		1962-1986 1962-1986
)5-407	US GEOL SURVEY	OSWEGO LAKE 2	394422	742645 744309	124PNPN	ira 🚻 🕶	1963-P
75-40R	LIS CECH SUBVEY	ATSION 2	304422	744309		. 0 4.	1963-P
)5-409	US GEOL SURVEY	ATSION 2 ATSION 3	394422 394422 394106	744309	121CKX		1963-P
05-570	US GEOL SURVEY	MOUNT	394106	743623	121000	Ÿ	1955-P
05-628 75-630	US GEOL SURVEY	PENN SF SHALLOW PENN SF DEEP	394452 394513	742819 742806	121CKID	¥	1936-P 1963-P
15-676	US GEOL SURVEY	COYLE AIRPORT	394914	742546	121CKKD 124PNPN	X	1962-P
)9-011	CAPE MAY CITY UD	CHCLD 1 085	385612	745457	121CNSY	A	1967-1986
U9-048	US GEOL SURVEY	CANAL 5	385748	745533 745056	121CNSY	A	1957-P
	US GEOL SURVEY	CAPE MAY 42CC	390213	745056	121CNSY	٥	1957-P
_09-081 3-013	US GEOL SURVEY	CAPE MAY 23HB CANOE BROOK 30	390211 404452	745055 742116	112HLBC 112SFDF	ŭ	1957-P 1950-P
3-014	EAST' ORANGE ND	NEUTRAL ZONE	404454	742021	112SFDF	ŭ	1926-P
3-017	WALSH BROS	BALLENTINE 8	404401	740834	227PSSC	Õ	1949-P
21-088	US GEOL SURVEY	HONEYBRANCH 10	402128	744613	227PSSC		1968-P
23-159	DUHERNAL WC	DUHERNAL OBS 5	402353 402438	742152	2110086	ÿ.	1939-1966 1938-1966
3-180 3-181	DUHERNAL WC PERTH AMBOY WD	DUHERNAL OBS 1 RUNYON 123	402442	742129 3 742136 ,	21100 86 21100 86		1955-1986
3-194	PERTH AMBOY NO	RUNYON 1	402536	742018.3	- 211FRNO	A. A. Sta	1934-P
23·265 23·270	CHEVRON OIL CO	11	402536	741612	211FRNG	W	1934-P 1950-1986
23-270	AMER CYANAMID	TEST 2	403251	741616 743529	211FRNG	Ä.	1950-1986
3 · 273 3 · 291	NJ WATER POLICY	PLAINSBORD POND	401932	743529	211MRPAN	Ų	1970-P 1965-P
3-292	MONROE TUP MUA	08\$ 1-1961 08\$ 2-1961	402109 402109	743013 743012	211FRMG 2110DBG	٥	1961-P
306	PHELPS DODGE CO	PHELPS DODGE 3	402147	742847	211FRHG	Ā	1969-1967
306 351 351	SAYREVILLE WD	SUD 2	402558	742013	2110086	W	1968-P
25-351	SAYREVILLE UD	SWD 1	402605	741959	21100 8 6	Ų.	1968-P
3-365	DUHERNAL WC	DUH SAY 4	402633	742120	211FRNG		1932-P
3-433	NJ WATER POLICY SOUTH RIVER ND	SO RIVER 4	402555 402633	742133 742200	2110086 211FRNG		1968-1986 1968-P
23-482	AMER CYANAMID	SRMD 2R TEST 1	403242	741617	211FRNG	â	1950-P
23-516	NOVAK, W	HULSART	402123	741849	211EGLS	u	1936-1984
75-250	GORDONS CRNR WC	VILLAGE 215	401918	741529	211EGL\$	Ã	1971-P
7-001	US GEOL SURVEY	RECREATION FLD	404432	742252	112SFDF	Ü	1967-P
27-002 27-003	US GEOL SURVEY	W B DRIVER 1	404738 404748	742406 742419	112SFDF 112SFDF	U	1966-P 1966-P
27-003	US GEOL SURVEY	W B DRIVER 2 CLEMENS	404816	742359	112SFDF		1966-P
27-005	US GEOL SURVEY	SANDOZ CHEM CO	404826	742347	112 SFDF		1966-P
7-006	US GEOL SURVEY	GREEN ACRES	404937	742347 742200	112 SFDF	U	1967-P
7-014	US GEOL SURVEY	ESSO SIX INCH	404705	742452 742 522	112SFDF	Ä	1967-P
27-015	MORRISTOWN ARPT	T2 MBMD 4	404743	742402	112SFDF		1960-P 1958-P
27-017 27-022	MADISON BORO WD	INT PIPE	404508 405209	742638	1128FDF 1128FDF	ŭ	1963-P
7-023	RANDOLPH ND	RUD HT FR 2	606921	743356	400PCHB	ŭ	1964-P
9-018	US GEOL SURVEY	IS BEACH 2	394829	740535	124PHPH	A	1962-P
9-020	US GEOL SURVEY	IS BEACH 4	394829	740535	121000	ň	1962-P
29-425	US GEOL SURVEY	WEBBS MILLS 2	395322	742252	124PNPN 121CIOD	. û	1962-P
29-513	US GEOL SURVEY	GARDEN ST PKY		745416 741418	121000	ŭ	1962-P 1962-P
9-514 9-530	US GEOL SURVEY PT PLEASANT WD	GARDEN ST PKY	400454	740413	211EGLS	Ā	1988-P
9-532	PT PLEASANT ND	PPND 3	400459	740359	211EGLS	. A	1986-1988
31-011	HANAQUE ND	HASKELL	410209	740359 741 706	112 SFDF	v	1965-1982
39-058	MAGRUDER COLOR	SCHWEITZER	404113	741216	227PSSC	Ý	1956-P
39-102	WHITE LABS INC	LAB 3	404113 404027 404043	741645	227PSSC	, ,	1952-P 1952-P
9-115	WHITE LABS INC	LAB 4	405726	741623	227PSSC 227PSSC	Â	1959-1987
9-133	ORIT CORP-	HATFIELD OBS	40372	14 1063	2217336	^	.,,,

See figure 13 for well locations.
P - Present
quifer unit: see definition of terms
C - (Water Condition): A-Artesian, W-Water table, U-Undetermined Lata available in the files of the New Jersey District Office.

QUALITY OF GROUND WATER

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989 UNION COUNTY

Ü	-WRD	S1 OWN	ITE		OCAL ITIFIER	LATII	TUDE	LONGITUD	E (1	ELEV. LAND SURF. FT. NGVD)	OPEN SCRE INTE (FT	ENED RVAL	AQUIFER UNIT
	MBER					404	106	0741719	į.	69	29	0*	#
39	0119	UNION	CO PARK	UNION CC	PARK OBS	404							
	I-WRD ÆLL IMBER	DATE	TEMPER- ATURE WATER (DEG C)	SPE- CIFIC CON- DUCT- ANCE (US/CM)	PH	CHLORO- BROMO- METHANE TOTAL (UG/L)	CHLO- RIDE TOTAL (UG/L)	1,2-DI- CHLORO- ETHANE TOTAL (UG/L)	BROMO- FORM TOTAL (UG/L)	CHLORO- DI- BROMO- METHANE TOTAL (UG/L)	CHLORO- FORM TOTAL (UG/L)	TOLUENE TOTAL (UG/L)	
39	20119	01-10-89	12.5	733	7.70	<0.20	<0.20	<0.20	<0.20	<0.20	0.00	10.20	
N.	J-WRD JELL JMBER	DATE	BENZENE TOTAL (UG/L)	CHLORO- BENZENE TOTAL (UG/L)	CHLORO- ETHANE TOTAL (UG/L)	ETHYL- BENZENE TOTAL (UG/L)	METHYL- BROMIDE TOTAL (UG/L)	METHYL- CHLO- RIDE TOTAL (UG/L)	METHYL- ENE CHLO- RIDE TOTAL (UG/L)	TETRA- CHLORO- ETHYL- ENE TOTAL (UG/L)	TRI- CHLORO- FLUORO- METHANE TOTAL (UG/L)	1,1-DI- CHLORO- ETHANE TOTAL (UG/L)	
-	90119	01-10-89	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.30	
_	J-WRD WELL LIMBER	DATE	1,1-DI- CHLORO- ETHYL- ENE TOTAL (UG/L)	1,1,1- TRI- CHLORO- ETHANE TOTAL (UG/L)	1,1,2- TRI- CHLORO- ETHANE TOTAL (UG/L)	1,1,2,2 TETRA- CHLORO- ETHANE TOTAL (UG/L)	1,2-DI- CHLORO- BENZENE TOTAL (UG/L)	CHLORO-	CHLORO	I 1,3-DI - CHLORO PROPENI TOTAL	- CHLORO- E BENZENI TOTAL	•	
	90119	01-10-89	8.7	16	<0.20	<0.20	<0.20	<0.20	0.30	<0.20	<0.20		
. 11	J-URD WELL UMBER	DATE	1,4-DI- CHLORO- BENZENE TOTAL (UG/L)	VINYL-	DI - FLUORO	1,3-DI- CHLORO-	1,3-DI	- CHLO-	ETHYL- ENE TOTAL	STYREN L TOTAL L) (UG/L)	TOT RE	c	
,	90119	01-10-89	4.20	<0.20	◆.20	⋖9.20	⋖0.20	<0.20	2.	8 40.2	2 40.2	2	

[·] Total depth of well

Aguifer Unit: # Passaic Formation of Jurassic-Trisesic age

REFERENCE NO. 23

DIRECTIONAL HYDRAULIC BEHAVIOUR OF A FRACTURED-SHALE AQUIFER IN NEW JERSEY

John VECCHIOLI, Geologist

U.S. Geological Survey, Trenton, N.J.

ABSTRACT

The principal source of ground water throughout a large part of central and northeastern New Jersey is the aquifer in the Brunswick Shale—the youngest unit of the Newark Group of Triassic Age. Large-diameter public-supply and industrial wells tapping the Brunswick Shale commonly yield several hundred gallons per minute each. Virtually all ground water in this aquifer occurs in interconnecting fractures; the formation has practically no effective primary porosity.

Numerous pumping tests have shown that the aquifer exhibits directional, rather than isotropic, hydraulic behavior. Water levels in wells alined along the strike of the formation show greater magnitude of interference than those in wells alined in transverse directions. Drawdown data evaluated by standard time-drawdown methods indicate computed coefficient of transmissibility in all cases is least in the direction of strike. Because of the distribution of observation wells available for the tests, distance-drawdown methods of evaluation could be used in only one instance—for just one direction; the computed coefficient compared favorably with that calculated from the time-drawdown method. from the time-drawdown method.

Computed values of transmissibility may be unreliable owing to the departure of the aquifer from the ideal model. It is even possible that the direction of minimum computed transmissibility is actually indicative of the alinement of fractures with greatest permeability. However, the relation of the directional behavior to the structure of the formation has practical significance when locating new wells near existing wells. Well interference can be minimized, generally, by alining wells perpendicular to the

Comportement hydraulique directionnel d'un aquifère situé dans les schistes fissurés du New Jersey

La principale source d'approvisionnement en eaux souterraines d'une grande partie du centre et du nord-est du New Jersey est l'aquifère situé dans les schistes de Brunswick; il s'agit de l'unité la plus jeune du groupe de Newark, d'âge triasique. Des puits à grand diamètre ont été forés pour les besoins des services publics et de l'industrie dans les schistes de Brunswick; chacun débite couramment plusieurs centaines de gallons par minute (1 gallon = 3,785 l). Presque toute l'eau de cet aquifère se trouve dans des fractures reliées entre elles; la formation n'a pratiquement aucune porosité primaire réelle.

porosité primaire réelle.

De nombreux tests de pompage ont montré que l'aquifère a un comportement hydraulique directionnel plutôt qu'isotrope. Le niveau des puits alignés suivant la direction de la formation accuse des interférences de plus forte amplitude que le niveau des puits alignés perpendiculairement à la formation. Les données relatives au rabattement de la nappe, calculées selon les méthodes habituelles de mesure de rabattement en fonction du temps, montrent dans tous les cas que c'est parallèlement à la direction des couches que le coefficient de transmissivité obtenu est le plus faible. Étant donné l'implantation des puits qu'il était possible d'utiliser pour les tests, les méthodes de mesure du rabattement de la nappe en fonction de la distance n'ont pu être appliquées qu'une seule fois, pour une seule direction; mais le coefficient obtenu se comparaît avantageusement avec celui qui avait été évalué par la méthode de mesure du rabattement en fonction du temps.

Il se peut que les valeurs ainsi obtenues de la transmissivité ne soient pas sûres en raison des différences existant entre l'aquifère réel et le schéma théorique. Il est même possible que la direction de la transmissivité minimale obtenue soit effectivement révélatrice de l'alignement des fractures de la plus forte perméabilité. Cependant, le rapport existant entre le comportement directionnel et la structure de la formation a une importance pratique lorsqu'il s'agit de forer de nouveaux puits au voisinage des puits déjà existants. Les interférences entre les puits peuvent généralement être réduites par l'alignement des puits perpendiculairement à la direction des couches.

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INTRODUCTION

Throughout much of the heavily populated central and northeastern part of New Jersey, the principal source of ground water is the aquifer in the Brunswick Shale. Indeed in many places it comprises the only source. The Brunswick Shale is tapped by numerous large-diameter public-supply and industrial wells, many of which have sustained yields of several hundred gpm (gallons per minute). Most of the high-capacity wells penetrate between 200 to 500 feet of rock.

The Brunswick Shale is the youngest unit of the Newark Group which is of Late Triassic (Keuper) age. The Newark Group crops out in a broad northeast-trending belt across northern New Jersey (fig. 1). It is more than 10,000 feet thick and consists of shale, sandstone, argillite, conglomerate, and basalt. In the western part of the outcrop

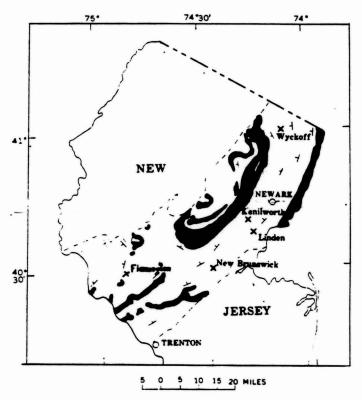


Fig. 1 — Map showing outcrop area and structure of the Newark Group in northern New Jersey (igneous rocks in black), and pumping-test sites.

area in New Jersey, the Newark Group consists, from oldest to youngest, of the following three units (Kümmel, 1897): Stockton Formation, chiefly sandstone; Lockatong Formation, mainly argillite; and Brunswick Shale. Diabase sills and dikes have intruded the Newark Group in this area. From New Brunswick northeastward, except for a narrow exposure of Stockton Formation flanking the Palisade Sill (diabase) along the State's eastern boundary, the Newark Group consists entirely of Brunswick Shale interlayered with Watchung Basalt. The Brunswick Shale is by far the thickest and

most extensive unit of the Newark Group. Deposits of till and stratified drift of the Wisconsin Stage of the Pleistocene Epoch mantle the Newark Group throughout the area northeast of New Brunswick.

Lithologically, the Brunswick Shale is mostly a soft red shale with some interbedded sandstone. The sandstone layers become more abundant and, on the whole, somewhat coarser toward the northeast, particularly near the northern State line.

The structural trend of the Newark Group is shown by the outcrop pattern of the generally concordant igneous rocks (fig. 1). The dominant strike is northeastward with dips ranging from 5° to 15° NW., but locally the strike of the sedimentary rocks differs markedly from the regional trend. Faulting has caused more complex structure locally, particularly in the western part of the belt.

Virtually all ground water in the Brunswick Shale occurs in interconnecting fractures that have resulted from jointing. This phenomena was recognized by Knapp (1904) where he states... "While our knowledge of the Newark beds is not sufficiently detailed to enable us to forecast the chances of obtaining artesian water at any given point, or even to assure us that well-defined water-bearing horizons exist, yet experience shows that a moderate supply of water can usually be obtained anywhere in these beds at depths of a few hundred feet at most. The fact that the rocks of the Newark system are thoroughly cut up by several systems of deeply penetrating joints, whose planes approach the vertical and intersect at various angles, and the further fact that in many wells the amount of water increases gradually with depth of the boring, apparently indicates that the water is present more largely in these joints and fissures than in any well-defined porous water-bearing beds. This inference is supported by observations made in several long tunnels in the red shale, where frequent streams of water were found following vertical fissures, while the bedding planes were nearly dry and no porous layers were observed."

Observations of joint set orientation made by the author at Newark and New Brunswick, by Anderson (private communication, 1963) near Linden, and by Nichols (private communication, 1964) near Flemington indicate that one set of vertical joints roughly parallels the strike of the rocks, whereas a second set is generally perpendicular to the strike. In places steeply dipping joints transverse to the aforementioned two occur. In addition, bedding plane joints are common in surface exposures. Major and minor faults also occur in the rocks of the Newark Group, with most of the faults trending largely northeastward.

HYDRAULIC BEHAVIOR

Regionally, water-table conditions prevail in the Brunswick Shale, but artesian conditions occur locally where marked differences exist in the vertical permeability of the formation. Artesian conditions exist also in some lowland areas where the Brunswick is overlain by relatively impermeable till or lacustrine clay and silt.

Data collected during numerous pumping tests of wells throughout the outcrop area indicate that the aquifer in the Brunswick Shale possesses directional, rather than isotropic, hydraulic properties. In describing two pumping tests made in Newark, Herpers and Barksdale (1951) report that all the wells that were observed to affect one another lay along lines trending in a general northeasterly direction. Similar effects were noted by Anderson (private communication, 1961) during pumping tests conducted at Linden. He found that in an observation well one mile northeast of a pumped well the water level dropped six feet within two hours of pumping, whereas pumping at higher rates from other wells located closer to but in different directions from the observation well had less of an effect on the water level in the observation well. At both Newark and Linden, the strike of the Brunswick Shale is N 45° E—the direction of most pronounced well interference.

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Similar effects have been observed in the central and western part of the outcrop area. After 24 hours of pumping of a well in New Brunswick, the water level in an observation well located 500 feet away directly along strike was lowered 87 feet, whereas that in another observation well located only 280 feet away but in a direction 30° from strike was lowered only 50 feet. Miller (private communication, 1965) reports that north of Trenton prolonged pumping of a high-capacity well adversely affected domestic wells about a mile distant along strike but other wells located equidistant in transverse directions were affected less. At the end of a 48-hour pumping test of a well near Flemington, the water level in an observation well 1,550 feet away along strike was drawn down 4.1 feet. The water level in an observation well only 1,200 feet away but in a transverse direction was lowered 3.7 feet.

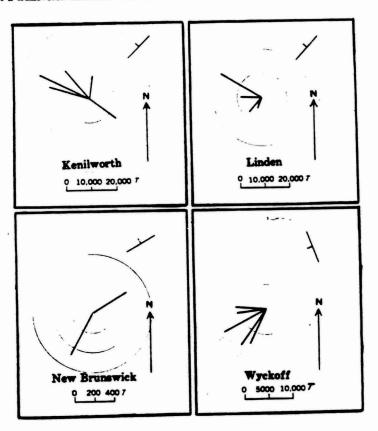


Fig. 2 — Directional transmissibilities computed from aquifer tests in the Brunswick Shale. Strike of formation shown in upper right corner for each site. Transmissibility, T, in gallons per day per foot, shown by ladder scale.

Hence, it is obvious that the anisotropic hydraulic behavior of the Brunswick Shale is not restricted to any particular area. Furthermore, the directional hydraulic behavior is evidently related to the structure of the formation. In all of the above tests, the wells alined parallel to the strike of the Brunswick Shale exhibited greatest mutual interference.

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Because the aquifer behaves anisotropically, the hydraulic characteristics derived by analyzing pumping-test data by conventional methods are questionable. Furthermore, in all pumping tests that have been run where drawdown observations have been made in more than one direction, analysis of the data has suggested a smaller apparent coefficient of transmissibility along strike and a greater one in the perpendicular direction (fig. 2). This appears to be incongruous with what is generally believed to be the alinement of the major fracture system.

In all the tests run to date except one, the distribution of observation wells was such that the data could be evaluated only by use of time-drawdown methods of analysis, that is, if data from the pumping well are not considered. For the pumping test conducted at Flemington, it was possible to make a distance-drawdown analysis for one direction. This test will be discussed in detail.

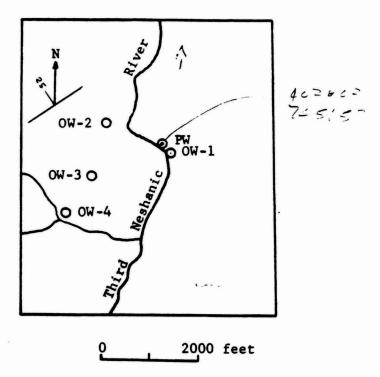


Fig. 3 — Map showing location of pumping well (PW) and observation wells (OW) used in the Flemington, N.J., pumping test.

Flemington test: The well pumped during this test consisted of a hole 10 inches in diameter and 300 feet deep of which only the upper 40 feet are cased. A pumping rate of 500 gpm was maintained continuously for a 48-hour period during which water-level observations were made on the pumping well, an unused well located 245 feet southeast of the pumping well, and three domestic wells located 1,200 feet west-northwest, 1,550 feet west-southwest, and 2,350 feet southwest, respectively, of the pumping well (fig. 3). Water-level measurements were made intermittently on the pumping well and the domestic wells with an electrical water-level indicator. A continuous record of the water level in the unused well was obtained prior to, during, and after the

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pumping period with an automatic water-stage recorder. The specific capacity of the pumping well at the end of the 48-hour period was 42 gpm/ft. At the test site the Brunswick Shale strikes N 53° E and dips 25° NW. (Nichols, private communication, 1964).

The stream which traverses the test site apparently was not an effective recharge boundary. Similarly, a northly trending narrow diabase dike that cuts the Brunswick Shale about 750 feet east of the pumping well apparently was not an effective discharge boundary. However, the farthest well observed (OW-4, fig. 3) was located near a tributary stream and a large pond, and the data from this well suggest some recharge may have been-occurring in this area. Two of the domestic wells were used intermittently during the test, but the quantity of water withdrawn from them is insignificantly small compared to the test rate of 500 gpm. The third well, that farthest from the pumping well, was used intermittently during the first day of the test, but the owner pumped it continuously during the second day at a rate of about 20 or 30 gpm, thus invalidating any observations at that well during the last 24 hours of the test.

If a time-drawdown analysis of the data is made (figs. 4 and 5), using the Theis nonequilibrium formula (Ferris and others, 1962), it is found that the computed coefficients of transmissibility and storage are, respectively:

Perpendicular to strike
$$\begin{cases} \text{Observation well No. 1} &= 88,200 \text{ gpd per ft; } 2.49 \times 10^{-4} \\ \text{Observation well No. 2} &= 75,400 \text{ gpd per ft; } 2.51 \times 10^{-4} \\ \text{Parallel to strike} \end{cases}$$

$$\begin{cases} \text{Observation well No. 3} &= 57,300 \text{ gpd per ft; } 2.51 \times 10^{-4} \\ \text{Observation well No. 4} \end{cases}$$

If a distance-drawdown analysis of the data is made (fig. 6), using the Theim equilib-

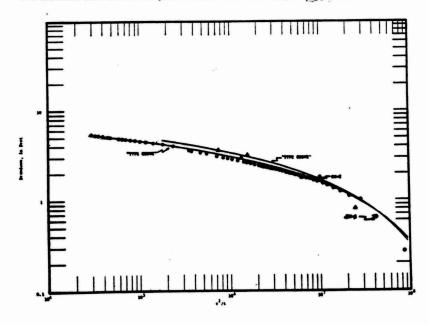


Fig. 4 — Logarithmic plot of time-drawdown data matched to the "Type Curve" for wells alined perpendicular to strike, Flemington, N.J., pumping test.

rium formula (Ferris and others, 1962), it is found that in the direction perpendicular to strike, the coefficient of transmissibility is about 100,000 gpd per ft—a value which compares favorably with that given for observation well N°. 1 above. As was mentioned previously, the data from observation well N°. 4 are thought to be affected by recharge; hence, a distance-drawdown analysis in the direction of strike could not be made on the basis of observed drawdowns. However, if one uses for the drawdown in this

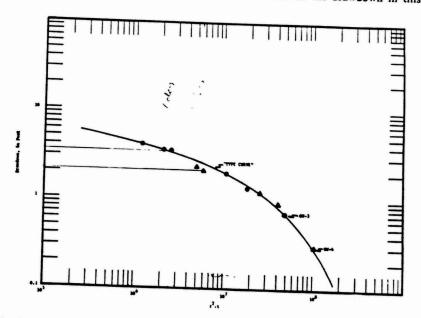


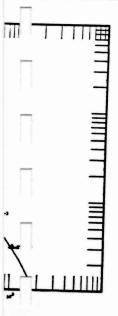
Fig. 5 — Logarithmic plot of time-drawdown data matched to the "Type Curve" for wells alined parallel to strike, Flemington, N.J., pumping test.

well at the end of one day the value obtained from the "Type Curve" in figure 5 and the observed drawdown value for observation well N°. 3, it is found that the computed coefficient of transmissibility is about 72,000 gpd per ft. Therefore, both methods of analyses have yielded comparable pairs of apparent values of transmissibility that are greatest perpendicular to strike and least parallel to strike.

CONCLUSIONS

That the aquifer in the Brunswick Shale exhibits directional rather than isotropic hydraulic behavior under pumping conditions is well documented. Furthermore, it has been demonstrated qualitatively for all parts of the outcrop in New Jersey that the maximum and minimum directions of anisotropy are related to the structural orientation of the Brunswick. The degree of anisotropy varies from place to place and is probably indirectly related to the productivity of the aquifer.

The validity of transmissibility values computed by standard methods are questionable, particularly where the degree of anisotropy is great. Indeed, if one takes the approach that direct interference in fracture porosity indicates that two wells tap a single fracture system whereas small drawdown indicates poor hydraulic connection between two wells, then one can conclude that the flow is not equal in all directions



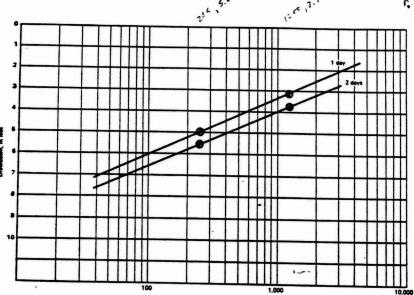
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consultation in figure 5 and and that the computed ore. oth methods of the sibility that are

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and hence that the smaller values of transmissibility indicate the direction of greater permeability—or the alinement of the major fracture system. A thorough discussion on the quantitative aspects of transmissibility values computed from pumping tests in fractured rocks is beyond the scope of this paper. Suffice it to say that extreme caution must be used when analyzing quantitatively drawdown data in fractured aquifers.



Distance, in geet

Fig. 6 — Relation of drawdown with distance from pumped well in the direction perpendicular to strike, Flemington, N.J., pumping test.

Of practical significance, however, is the directional orientation of the hydraulic anisotropy exhibited by the aquifer. Owing to the apparent relation of the hydraulic anisotropy to the strike of the Brunswick Shale, it is evident that well interference can be minimized by alining wells in directions other than parallel to the strike. The local strike of the Brunswick can be determined readily from geologic maps or by an examination of outcrops in the area. Finally, it is easy to see how knowledge of the hydraulic anisotropy of an aquifer can lend considerable insight in the evaluation of existing or potential ground-water contamination and saltwater encroachment problems.

ACKNOWLEDGMENTS

This paper is an outgrowth of the ground-water investigatory program being conducted in New Jersey by the U.S. Geological Survey in cooperation with the State Department of Conservation and Economic Development, Division of Water Policy and Supply.

The author is grateful to his colleagues in Trenton, N. J. for their critical discussions and assistance. He is especially thankful to Mr. Henry R. Anderson, geologist, USGS, Sokoto, Nigeria, who helped formulate early thoughts on this subject during his tenure in Trenton; however, the author assumes sole responsibility for the conclusions stated herein.

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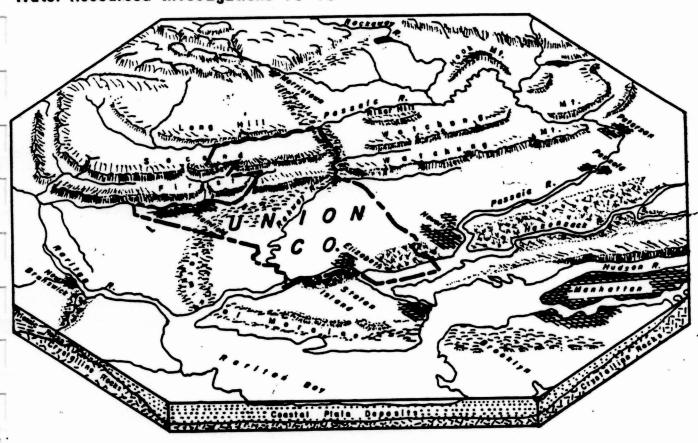
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REFERENCE NO. 24

GEOLOGY AND GROUND-WATER RESOURCES OF UNION COUNTY, NEW JERSEY

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 76-73



Prepared in cooperation with

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, DIVISION OF WATER RESOURCES



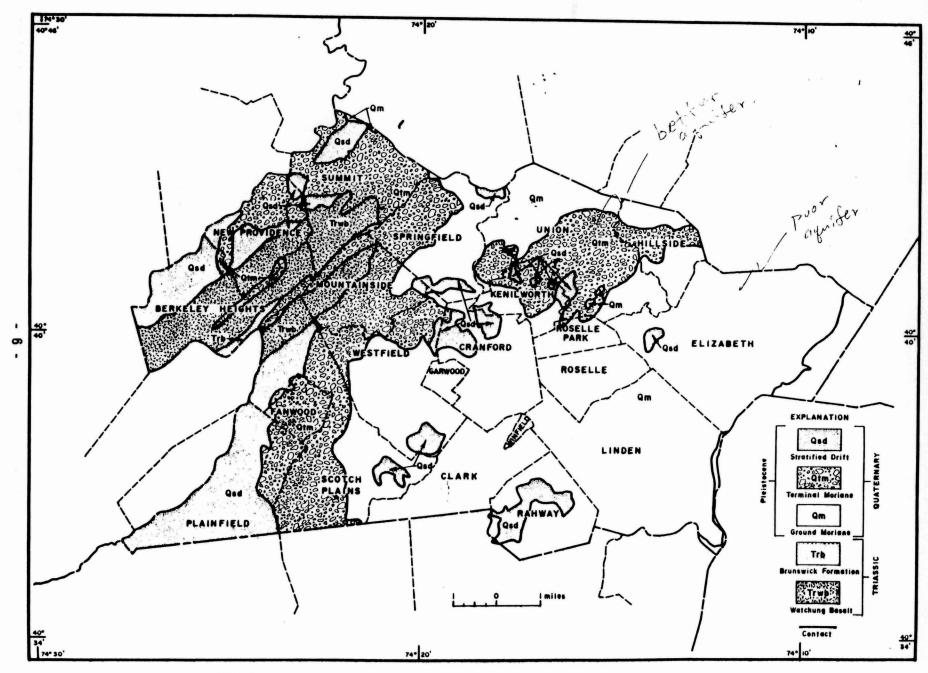


FIGURE 3. -- GENERALIZED SURFICIAL GEOLOGIC MAP OF UNION COUNTY, NEW JERSEY.

Industrial Products	Number	r of	Establ
Chemicals and allied products			104
Fabricated metal products			226
Machinery, except electrical			275
Food and kindred products			71
Miscellaneous manufacturing			77
Printing and publishing			113
Furniture and fixtures			34
Instruments and related products			25
Textile mill products			14
Stone, clay, and glass products			26
Rubber and plastics products			63
	Total	1	,424

lishments

(New Jersey Department of Environmental Protection, 1967)

GEOLOGY

Newark Group

During the Late Triassic Epoch downfaulting produced a series of northeast-southwest trending basins in the Piedmont Plateau from Nova Scotia to North Carolina. Sedimentary and associated igneous rocks of Triassic age occupy the downfaulted basins and are known as the Newark Group. In New Jersey the Newark Group crops out in a band 16 to 30 miles wide trending northeast-southwest from the Delaware River to the Hudson River (fig. 1). Union County lies entirely within this band.

The Newark Group in New Jersey contains 15,000 to 20,000 feet of non-marine shales, mudstones, sandstones, conglomerates, and basic igneous rocks that unconformably overlie rocks of Paleozoic and Precambrian age. The sedimentary rocks of the Newark Group were largely derived from Paleozoic and Precambrian rocks to the southeast and deposited in a non-marine intermontane basin (Van Houten, 1965). During Triassic time the sedimentary rocks were intruded by a diabase sill, dikes, and covered by several flows of basalt.

The Newark Group underlying Union County consists of the Brunswick Formation and Watchung Basalt. The generalized geologic map (fig. 4) shows the areal distribution of the Triassic rocks underlying Union County. Figure 5 is a generalized section showing the geology and structure of Union County.

The Brunswick Formation consists of thin-bedded shales, mudstones, and sandstones which range in color from reddish-brown to gray. The reddish-brown color originates from reworked hematite which comprises 5 to 10 percent of the formation (Boch, 1959). The minerals of the Brunswick Formation include quartz, illite, muscovite, feldspar. and small amounts of calcite and gypsum. Primary structures such as ripple marks and mud cracks indicate that the Brunswick Formation was deposited in a shallow-water environment.

The regional strike of the Brunswick Formation in Union County is N50°E with dips 9° to 13°NW. The major joint sets strike approximately N45°E and N75°W and both sets have a vertical dip. The thickness of the formation is 6,000 to 8,000 feet.

The Watchung Basalt consists of three extensive basaltic lava sheets that are intercalated with the sedimentary rocks of the Brunswick Formation. The basalt flows are more resistant to erosion than the shales, mudstones, and sandstones and form prominent ridges. Two of the three lava sheets occur in Union County and form the First and Second Watchung Mountains. The third sheet forms a discontinuous ridge known as Long Hill and Hook Mountain in Morris County to the west of Union County.

The basalt flows are volcanic extrusive rocks which were formed by the outflow of lava onto the land surface. Rapid cooling of the flows produced a dense, aphanitic rock. Phenocrysts are present in the ground mass which give the basalt a porphyritic texture. The phenocrysts are usually augite and in some cases feldspar. The ground mass for the most part consists of augite and feldspar.

The basalt sheets vary in thickness from less than 300 feet in parts of the Long Hill flow to a maximum of about 1,200 feet in parts of the Second Watchung Mountain. The Second Watchung Mountain is a double flow sheet separated by a thin section of the Brunswick Formation. The thickest flow sheet is the upper flow of the Second Watchung Mountain which has a maximum thickness of about 800 feet.

Quaternary Deposits

Unconsolidated sediments deposited by glaciers or by glacial melt-water during the Pleistocene Epoch mantle the bedrock surface in Union County. These deposits consist of clay, silt, sand, gravel, and boulders. They are glacial, glaciolacustrine (deposited by glacial meltwater in lakes), or glacial fluvial (deposited by glacial meltwater in streams) in origin.

The Pleistocene sediments fall into three general classes: (1) end moraine--a moraine jointed across the course of a glacier at its farthest advance; (2) ground moraine--the material carried forward in and beneath the ice and finally deposited from its under surface; and (3) stratified

drift--deposits from glacial meltwater exhibiting both sorting and stratification. The stratified drift includes lacustrine (deposited in lakes) and fluviatile (deposited in streams) sands and clays.

Figure 3 is a surficial geologic map of Union County showing the extent of the end moraine, ground moraine, and stratified drift. West of the end moraine near Scotch Plains and Plainfield, stratified drift forms an outwash plain (fig. 3).

Before the last glaciation the rivers draining Union County cut deep valleys into the Brunswick Formation (fig. 2). Subsequently the valleys were filled and buried by glacial material. The thickness of the glacial deposits is controlled largely by the underlying bedrock topography. Figure 6 consists of three sections showing the altitudes of the bedrock valley floor and thickness of Pleistocene deposits in the bedrock valleys. These buried channels underlie parts of Hillside, Union, Springfield, Clark, and Scotch Plains Townships, and the Boroughs of Mountainside, New Providence and Kenilworth and the Cities of Summit and Rahway.

The Pleistocene sediments in the bedrock channels consist of unstratified and stratified clay, silt, sand, and gravel. Only the sand and gravel deposits of the stratified drift will yield large quantities of water to wells.

Deposits of Holocene (Recent) age cover only small areas and include river alluvium, and eolian deposits.

The stratigraphic units in Union County and their geologic and hydrologic characteristics are given in Table 1. Table 6 contains representative well logs indicating the variations in the lithologies of the geologic units.

GROUND WATER HYDROLOGY

Introduction

Water is continually being exchanged in a circulatory pattern between the earth and the atmosphere. In general, the amount of precipitation ultimately determines the amount of water available for man's use. Some of the precipitation that falls on land evaporates where it falls, some is absorbed by plants that later transpire the water back to the atmosphere, some flows overland to streams, and some infiltrates into the ground to become ground water. The ground water is discharged to streams, and streams flow to the oceans where the water can be evaporated back to the atmosphere.

Table 1.--Geology and hydrology of the rock units in Union County, New Jersey

			Fo	rmation or	Thickness		
Era	Period	Series	lithologic unit			Lithology	Hydrologic characteristics
Cenozoic		Holocene	•lluvíum		0-25	Sand, silt, and mud in and along river channels.	Relatively impermeable deposits; retard intrusion of saline water through river beds.
	rnery			eolian deposits	0-10	Sand	Above water table; high rate of infiltration.
	Quaternary	Pleistocene		un- tratified drift (till)	0-200	Unstratified clay, sand and gravel; reddish brown in color. Forms the ground and end moraine deposits. Deposited by glaciers.	Because of low permeability, it is not an important aquifer in the County.
				stratified drift	0-60	Sand and gravel lenses which are stratified. Occurs as lenses in the till in the bedrock channels and interbedded with till in the end moraines. Deposited by water. Unconformity	Important as an aquifer in the City of Rahway and in Union, Hillside and Springfield Townships and in Kenilworth Borough. At the City of Rahway and Hillside Township wells induce recharge from rivers.
Mesozoic - Triassic	a	Triessic	Group	Brunswick Formation	6,000-8,000	Interbedded, soft red shales, mudstones, and sandstones. Adjacent to the Watchung Basalt it is altered to a hornfels.	Most extensive and most important aquifer in Union County. Water stored in and transmitted along fracture and joint systems which decrease in number and volume with depth. Both artesian and water-table conditions exist.
	-	Upper T	Newark (Watchung Basalt	300-800	Basaltic lava sheets inter- calated with the sedimentary rocks of the Newark Group. Two of the sheets crop out in Union County. The basalt is a dense, aphanitic, extrusive rock. Augite and feldspars are the chief minerals.	Minor aquifer in the county. Well yields are low to moderate.

REFERENCE NO. 25

Hydrogeology of the Brunswick (Passaic) Formation and Implications for Ground Water Monitoring Practice

by Andrew Michalski

Abstract

Fractured shales of the Brunswick Formation provide a major aquifer in the most industrialized region of New Jersey. Numerous cases of ground water contamination have been documented in this formation. However, effectiveness of monitoring and remediation efforts is often hampered by the use of inappropriate concepts regarding ground water flow controls in this complex aquifer system. One such concept presumes that near-vertical fractures parallel to the strike of beds provide principal passages for the flow and produce an anisotropic response to pumping stress. Field evidence presented in this paper confirms that the Brunswick Formation hosts a gently dipping, multiunit, leaky aquifer system that consists of thin water-bearing units and thick intervening aquitards. The water-bearing units are associated with major bedding partings and/or intensely fractured seams. Layered heterogeneity of such a dipping multiunit aquifer system produces an anisotropic flow pattern with preferential flow along the strike of beds. Within the weathered zone, the permeability of the water-bearing units can be greatly reduced. The commonly used hydrogeologic model of the Brunswick as a one-aquifer system, sometimes with vaguely defined "shallow" and "deep" zones, often leads to the development of inadvertent cross-flows within monitoring wells. If undetected, cross-flows may promote contaminant spread into deeper units and impair the quality of hydrogeologic data. Hydrogeologic characterization of the Brunswick shales at any given site should be aimed primarily at identification of the major water-bearing and aquitard units. Recommended techniques for this characterization include fluid logging and other in-well tests.

Introduction

The Brunswick Formation is the thickest (about 10,000 feet) unit of the Newark Group (Kummel 1897) that crops out over a region stretching from southern New York state through northern and central New Jersey into eastern Pennsylvania (Figure 1). Throughout most of its outcrop, the Brunswick Formation provides a principal source of ground water. Numerous domestic, industrial, and municipal wells tap the formation with pumping rates ranging from a few to several hundred gallons per minute. In recent years, many of the water supply wells completed in highly industrialized and urbanized outcrop areas have been found to be contaminated and taken out of service. In the last decade, a dramatic increase in the number of monitoring wells installed in the Brunswick Formation has been observed.

The water-supply aspect of the Brunswick hydrogeology has been dealt with in a number of county-wide reports, which emphasize mostly statistical data on various types of water-supply wells. The issues of ground water distribution, movement, and potential contaminant migration pathways (which are important for proper design of ground water monitoring systems) have received little attention. Moreover, there appears to be

a good deal of confusion on these issues in the published literature, which has occasionally led to improper monitoring practices.

Based on a review of the literature and field data from several sites in New Jersey, this paper attempts to reconcile often disparate concepts of ground water occurrence and flow in the Brunswick Formation. A more realistic conceptual flow model is proposed for the formation, together with guidelines for monitoring practices. Though this paper deals only with the Brunswick, much of its content may apply to other bedrock formations of the Newark Basin.

Concepts of Ground Water Occurrence and Movement in the Brunswick Formation

The Brunswick Formation consists of non-marine reddish-brown mudstone, shale, siltstone, and sand-stone, which are interbedded with conglomeratic sand-stones along basin margins. Three major basalt flows and diabase intrusions are present within a sequence of lenticular strata, which generally strike NE-SW and dip NW at 5 to 25 degrees (Figure 1). Locally, the strata are gently warped and broken by a few large faults and many small ones. Olsen (1980) named the thicker, Triassic (pre-basalt) portion of the Brunswick as the Passaic

Formation and further subdivided its post-basalt, Jurassic portion. Although the sites indicated in Figure 1 are located within the Passaic Formation, the older stratigraphic term is retained in this paper because terms like the Brunswick or Triassic "Aquifer" have an established use in the hydrogeologic literature.

Systematic fractures, both near-vertical joints and partings along the bedding, are generally believed to provide the principal passages for ground water flow through the Brunswick Formation. Even in conglomeratic lithofacies developed at the basin margins, the fracture permeability appears to dominate the bulk of formation permeability, despite sandstone matrix porosity values of up to 20 percent (Perlmutter 1959).

Ground water in the formation is said to occur under both water table and confined conditions. Rima (1955) identified the "unconfined" zone in the Lansdale (Pennsylvania) area, based on electric logs and flowmeter logs obtained while injecting water into selected wells. The low resistivity combined with a small but continuous decline in flow of injected water with depth was interpreted as indicative of higher water storage and lower permeability of this zone associated with weathered shales.

According to Rima (1955), the unconfined zone occurs to a maximum depth of about 250 feet, below which one or more artesian or semiartesian aquifers occurs to a maximum depth of about 600 feet. Where the bedrock is mantled by low-permeability drift or alluvium, a confined condition may exist at shallow depth in lowland bedrock areas (Gill and Vecchioli 1965, Nichols 1968, Nemickas 1969).

The notion of a multizone aquifer system within the Brunswick has generally been accepted by other researchers (e.g., Barksdale et al. 1958, Perlmutter 1959, Carswell 1976, Houghton 1986). Although the reported thickness of individual water-bearing zones has varied, it was considered rather small. Rima (1955) and Barksdale et al. (1958) estimated the thickness as generally less than 20 feet, while much smaller values (from a few inches to a few feet, with the average about 2 feet) were given by Longwill and Wood (1965) for beds in which secondary openings are well developed.

Differences in permeability between the layers, resulting either from variation in fracturing, weathering, or a combination of both, have been argued (Nichols 1968, Nemickas 1969) to account for the presence of the many water-bearing units and for substantial head differences often measured between the units (Perlmutter 1959, Carswell 1976). Because their relation to lithology is not clear, and strata are commonly lenticular, the individual water-bearing units have been difficult to define and to correlate. This has often led to a haphazard development of ground water supplies (e.g., Carswell 1976) and improper installation of monitoring systems (e.g., case described by Stothoff, 1990).

The directional, anisotropic response to pumping stresses is a well-documented feature of the Brunswick Formation in the region. In most cases, observation wells aligned along the strike of the formation react faster

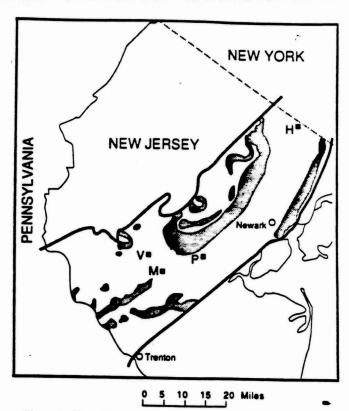


Figure 1. Map showing outcrop area of the Newark Group in New Jersey (between the heavy lines), igneous rocks (shaded areas), and locations of sites referenced in the text.

and show much greater drawdown than observation wells situated perpendicular to the strike (Herpers and Barksdale 1968, Vecchioli et al. 1969). However, some confusion exists as to possible causes of the observed anisotropic response of the formation. Is this behavior caused by an alignment of the principal set of near-vertical fractures subparallel to the strike? Is it that the observed anisotropic response is due to the fact that wells located perpendicular to the strike of a dipping set of heterogeneous strata may penetrate different aquifer zones than the pumped well? Or is it some combination of both causes?

The first concept can be traced back to a paper by Herpers and Barksdale (1951) which discussed results of a pumping test in Newark, New Jersey. The authors argued that, with increasing depth, the weight of overlying materials would tend to close near-horizontal bedding fractures which tend to distribute water uniformly in all directions, while the near-vertical fractures would be less affected at depth, accentuating the tendency of water to flow in the direction of prevailing vertical cracks along the strike. They envisioned that individual vertical fractures might transmit water for distances of up to 2 or 3 miles without interruption, and that locally the fractures would extend to the top of bedrock, providing the hydraulic contact to the ground surface.

The concept that anisotropic behavior of the Brunswick strata is controlled by the alignment of vertical fractures along the strike of strata has been echoed in many later publications and reports (e.g., Vecchioli 1967, Nichols 1968, Spayd 1985).

On the other hand, there have been reports of sub-

stantial permeability variations in vertical profiles of wells, occurrences of discrete productive zones in association with bedding, and internal flows in wells in Pennsylvania (Rima 1955, Longwill and Wood 1965), southern New York state (Perlmutter 1959), and in New Jersey. At a site near Trenton, Vecchioli et al. (1969) documented the occurrence of ground water mainly in discrete zones controlled by bedding. The effect of tapping different producing zones on drawdowns measured during pumping was also evident at that site. Carswell (1976) characterized the ground water system in the Brunswick of northern New Jersey as consisting of a series of alternating tabular aquifers and aquicludes several tens of feet thick, which extended downdip for a few hundred feet and were continuous for thousands of feet along strike.

Field Evidence

Internal Aquifer Structure

Although any combination of the two presented concepts on control of fracture flow in the Brunswick shales can be envisioned, this author's data from a number of sites fit the latter concept. A conceptual model of the Brunswick Formation proposed herein embodies a "leaky," multiunit aquifer system, which consists of thin water-bearing units and much thicker, strata-bound, intervening aquitards. Both the water-bearing units and the aquitards are part of a homoclinal structure with a typical dip in the range of 5° to 25°. On the whole, such a structure is inherently anisotropic with the least permeability axis oriented perpendicular to bedding. The structure is capped by a weathered zone of lower permeability.

Figure 2 provides an example of the internal structure of the Brunswick Aquifer system at Site "P," where the formation is made up predominantly of mudstones. Three major discrete water-bearing units (designated on Figure 2 with letters A, B, and C) have been distinguished based on observations made during well drilling, temperature and electrical conductivity logging, inwell flow tracing, and slug testing. These major water-bearing units as well as several minor units are thin and

separated by much thicker aquitards. In the construction of the cross section in Figure 2, information from some wells was projected over distances of several hundred feet (See map in Figure 2).

Despite such a distant projection, a consistent arrangement of the units parallel to the bedding is evident, implying a significant lateral extent for these major water-bearing units at Site P.

Ground water flow appears to be primarily influenced by partings along bedding and by the contrast in degree of fracturing.

Regarding their nature, the discrete water-bearing units in Figure 2 may represent larger bedding plane partings or seams of densely fractured rocks. The bedding partings provide a special class of fracture passages, not only because of their different origin, but also due to their consistent orientation and greater extent than any other fracture type. The greater extent of bedding discontinuities also tends to reinforce the effect of permeability anisotropy resulting from variations in fracturing and permeability between individual beds.

An earlier belief that bedding partings in the Brunswick play a minor hydraulic role because of their closure under increased vertical stress with depth (Herpers and Barksdale 1951) needs to be revised. The in situ stress distribution is often more complex than predicted from a simple model of gravitational stresses. The vertical stress at shallow depth may be less than horizontal stresses due to stress release in overconsolidated and partially eroded formations such as the Brunswick. Consequently, some bedding partings may become more open than vertical fractures. Besides, the flow within a bedding fissure should be visualized as occurring through channels meandering in between asperities that transmit load across the fissure walls.

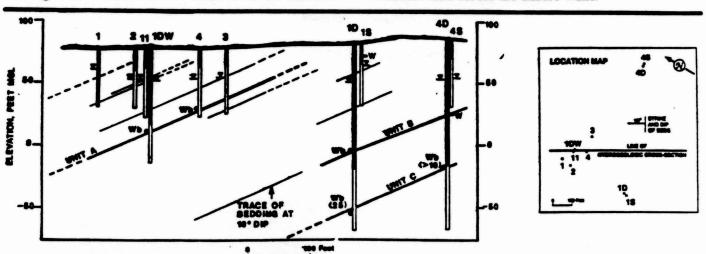


Figure 2. Hydrogeologic cross section and location map for Site P. Letter W at well bores indicates depth at which water was encountered during drilling by air-retary method, Wb indicates water flowing from the hole, and number in parentheses gives floweste in gallons per minute.

Michalski and Klepp (1990) documented a case in northern New Jersey in which substantial flows occurred through discrete bedding partings in a sequence of predominantly thick sandstone beds of the Brunswick Formation. This site is designated as Site H on Figure 1. The significant role of bedding planes in controlling ground water flow is reported from other sedimentary basins (e.g., Trainer 1968).

Contrast in bed fracturing within the vertical profile of strata is the other major factor capable of producing discrete aquifer zones. Trends governing differential fracturing of beds need to be discussed. It has been known from fracture measurements in other sedimentary basins (e.g., Harris et al. 1960) and from theoretical considerations (Price 1966) that the frequency of systematic fractures/joints within individual units of a heterogeneous sequence is mostly controlled by the lithology ("competence") of each unit, its thickness, and the degree of tectonic deformation experienced by the sequence. A more competent bed tends to exhibit lower fracture frequency than a less competent one. For a given lithology and local tectonic history, the frequency should be inversely proportional to bed thickness (Price 1966).

Based on these rules, one can expect that thicker units of stiffer and stronger beds will exhibit fewer fractures than intervening thin beds of weaker lithologic types. In the case of the Brunswick sequence shown in Photo 1, fewer vertical fractures can be seen in thicker and more resistant mudstone beds than in shale seams. Conceivably, in such a sequence, the massive mudstone would act as an aquitard while the shale seams could furnish the production or water-bearing zones. The cyclic character of deposition of the Triassic formations (Van Houten 1969) has resulted in multiple repetitions of similar sequences at consistent intervals. The occurrence of multiple aquifer/aquitard sequences can thus be anticipated in these formations.

In addition to the most numerous, strata-bound fractures (to which the earlier discussion applies), several widely spaced, near-vertical fractures run across the sequence (Photo 1). These pervasive fractures impart a leaky character to the entire sequence. Due to the large apertures commonly found in these fractures, considerable leakage may be sustained at favorable in situ stress conditions in the absence of fracture infillings.

Distributions of Hydraulic Heads and Permeability

Apparent irregularities of the potentiometric surface are common at many monitored sites in the region. Water-level elevations in wells 1 and 1S on Figure 2 provide examples of such apparent anomalies; elevations observed in these wells are substantially higher than water-level elevations in nearby wells of similar



Photo 1. Fragment of exposure of partially weathered Brunswick Formation at Route 18 in New Brunswick, New Jersey. A thick cand-stone bed (indicated by the hammer and light color) shows few fractures, while intervening shales are densely fractured and water-hearing (dark color).

depth. In this particular case, the differences appear to result from positioning of open well intervals within different units of the formation. Wells 1 and 1S are open into aquitard units while other wells intersect intervening water-bearing units. Significant head differences can exist between individual units. Unless the structure of a multiunit aquifer is defined and the position of open well intervals with respect to the structure is accounted for, erroneous conclusions may be drawn from water-level data regarding the ground water flow direction and hydraulic gradients.

Wells in which significant cross-flows occur should be considered to be improperly installed.

Figure 3 shows a composite plot of depths to static water level vs. depth of wells for a total of 37 wells from three sites in the Brunswick Formation. A trend of an increasing depth to water level with increasing well depths is evident at sites M and V. This trend indicates the presence of strong downward gradients at both sites, which is a typical feature of recharge zones. The topography of sites M and V implies the occurrence of a recharging regime in the local shallow flow systems. The trend is not seen in wells installed at Site P, but a gentle topographic slope across the site and its position with respect to the nearest streams suggest that the site may be situated in a transition zone between recharging and discharging flow regimes.

In addition to the structure and topography, the observed distribution of hydraulic heads is largely influenced by weathering-related permeability changes with depth. In general, the weathering processes in shales result in the reduction of the primary fracture permeability by clogging the more conductive fractures with clay. The changes appear to be superimposed on the permeability variation inherent in the structure of multiunit bedrock aquifer system.

Figure 4 presents trends in distribution of the bulk hydraulic conductivity values (obtained from routine slug tests) vs. depth of open intervals in monitoring wells at two sites. The values obtained range over four orders of magnitude, from 10⁻⁶ to 10⁻² cm/s. The lowest hydraulic conductivity values came from shallow wells that were completed within aquitard units, and higher values for shallow wells were associated with wells intersecting near-surface reaches of identified major waterbearing units (Figure 2). Wells open below a depth of 50 to 60 feet appear to intercept a transition from an intensely weathered shallow zone to an unweathered zone. Deep monitoring wells provided higher values of the bulk hydraulic conductivity and a lower variability of this parameter (Figure 4B).

Although weathering tends to reduce the permeability, numerous secondary fractures formed in the process

DEPTH TO WATER LEVEL, FEET

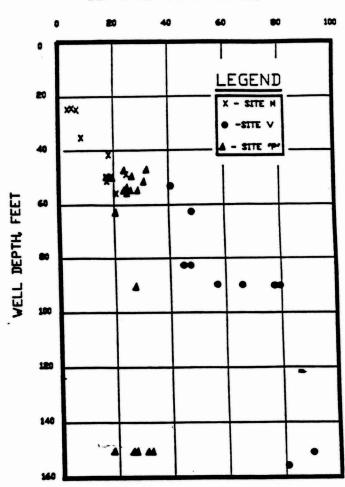


Figure 3. Relation of depth to water level with well depth for 37 monitoring wells at three sites in the Brunswick Formation.

may augment the storage potential of the weathered zone. As a result, pockets of perched water often form within and above the zone.

Preferential Flow in Undisturbed Aquifer System

The occurrence of a stratigraphy-controlled, multiunit aquifer system within the dipping bed setting tends to produce an anisotropic pattern of ground water flow.

In the saturated zone, primary flow is generally restricted to bedding fissures and fractured beds along strike. Usually, only minor deflections from that direction are attributable to the topography, flow boundaries and transient effects. However, the vertical flows may prevail across aquitards separating the aquifer units and in the weathered zone. These general principles can be useful in assessing the contaminant migration pathways within the Brunswick Formation provided that major aquifer and aquitard units beneath a site are located and sufficiently characterized.

Suggested Monitoring Practice

Contaminant investigations at sites located above the Brunswick Formation commonly involve installation of two sets of monitoring wells. The sets are usually referred to as the shallow and the deep wells, and are intended to monitor vaguely defined "shallow" and "deep" zones of the aquifer system.

The shallow wells are usually installed to span the first water-bearing zone noticed during installation of these wells. Completion depth of deep monitoring wells is sometimes determined by a typical depth of water-supply wells in the area. In other cases, the deep wells are drilled to an arbitrarily pre-selected depth (such as 100 or 150 feet). There is a tendency to complete all monitoring wells of a given set to a similar depth. Usually, the monitoring wells are 6-inch holes with open interval length ranging between 20 feet and several hundred feet.

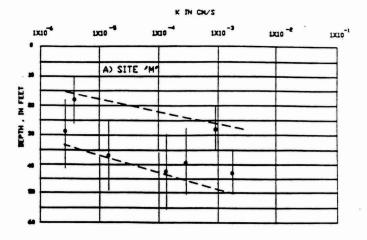
The observed distribution of hydraulic heads is largely influenced by permeability changes.

Installation of 6-inch diameter wells in low-permeability portions of the Brunswick Formation can lead to significant errors in head measurements, which stems from large well storage and time lags in response to water-level changes in wells of larger diameters (Freeze and Cherry 1979). Time lags of up to two weeks were observed in some wells open to aquitard units and the weathered zone, while in wells open to major waterbearing zones the observed time lags were very short. Where permeability values obtained from wells at a site differ by four orders of magnitude (as depicted in Figure 4B), the variability of the response time among wells is yet another factor complicating interpretations of waterlevel measurements and pump-test data. Because the time lag is directly proportional to the square of the well radius, the use of smaller diameter holes is recommended for monitoring wells in the weathered zone.

The practice of well installation to an arbitrary target depth and of treating the Brunswick Formation as if it were one aquifer (or a two-zone aquifer) may be convenient for the design of ground water monitoring systems and for logistics of well drilling. However, the lack of consideration of the not-so-apparent internal structure of the aquifer system and of the 3-D nature of transport can bring about inadvertent detrimental side effects.

Of most concern is the chance of triggering crossflows within open segments of wells caused by inadvertent bridging of aquifer units with different heads and/ or transmissivities. Because of the trend of increasing hydraulic conductivity with depth of weathered zone (Figure 4), the chance of cross-flows is high for wells with longer intervals open across this zone, particularly for sites in recharge areas. If present, such cross-flows may affect or alter a pre-existing pattern of ground water flow, possibly inducing contaminant migration through the well into deeper bedrock units (e.g., Michalski and Klepp 1990). The potentiometric and chemical data obtained under such circumstances would be ambiguous, misguiding the development of remedial measures.

Wells in which significant cross-flows occur should



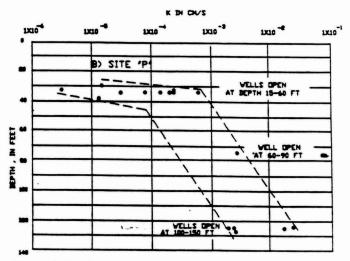


Figure 4. Distribution of vertically averaged hydraulic conductivity values vs. depth of open intervals of monitoring wells at sites M and P. Mid-points of open intervals are denoted by points, and vertical segments on the upper plot (Site M) represent the intervals.

be considered improperly installed monitoring wells. The use of short open intervals (generally less than 20 feet) helps to reduce the possibility of creating crossflows. On the other hand, the placement of wells with shorter open intervals is not an easy task in situations in which a thick and apparently monotonous formation provides few clues on the location of potentially important water-bearing and aquitard units. Therefore, a trial-and-error approach to well placement in the Brunswick may be justified if inadvertent placement errors are rectified in a timely manner...

To this end, there is a need to employ investigation techniques capable of locating major aquifer units and detecting internal leaks in wells. These techniques are outlined in following text. If a significant leak is detected in an existing well, such a well should be retrofitted to stop the leak. At new sites, pilot test wells may be drilled first, tested for internal leaks, and then retrofitted if needed. Retrofitting can be accomplished either by grouting a length of open interval from the well bottom, or by equipping the well with a permanent multipacker monitoring system. Cherry and Johnson (1982) and Black et al. (1987) provided descriptions of such multilevel systems. From the cost-effectiveness standpoint, the use of commercially available devices for multilevel

TABLE 1

Advantages and Limitations of Hydrogeologic Characterization Techniques Applicable to the Brunswick Formation

	to the Brunswick Formation
Technique	Information sought, advantages, and limitations
Surface Techniques	
Hydrogeologic Mapping	Bedrock lithology and structure, soil types, hydrologic features and flow boundaries. Less effective in the presence of thick soil mantle.
Test Pits/ Trenches	Thickness and character of soil/weathered zone, lithology, dip and strike of bedrock, orientation, spacing and character of fracture systems, presence of shallow water zones. Can be combined with soil sampling and the use of contaminant-sensing devices. Experienced geologist needed to obtain quality data.
Drilling Techniques	
Drilling/Logging and Well Installation	Air-rotary is preferred drilling method. Lithologic variations determined from cuttings and drilling rates ("hard" and "soft" zones). Position of major producing zones can be ascertained, and inflows associated with each zone can be estimated/measured. Wet zones above the standing water level can also be located.
Coring .	Lithology and fracture characteristics can be evaluated, and formation samples can be taken for lab analysis. Some fractures can be induced by drilling. Generally expensive. Core recovery and quality dependent on geology and drillers performance, usually poor in fracture zones.
Intra-Well Techniques	*
Downhole Video Survey	Fracture traces, apertures, and frequency, lithologic contacts, borehole wall profile, water seeps from fractures above the standing water level can be viewed in an open-hole TV survey. Watertightness of casing joints and grouting can be ascertained. Requires clean well water. (Acoustic televiewer was developed for mud-filled wells).
Cemperature and Electrical Conductivity ogging	Locations of major transmissive fractures, possible vertical flows in a well, and water quality can be inferred from inflections of the logs. Qualitative. Inexpensive downhole probes are available and the logging is fast.
Other Geophysical Logs	Caliper, natural gamma, SP, and electric logs may provide information on lithology and in situ water quality. Specialized logging (such as acoustic wave form logging to infer fracture permeability) is still experimental.
lowmeters	Velocity and vertical flows (either spontaneous or induced by pumping) within a well can be measured. Impeller-type meters stall at velocities less than 5 ft/min. More sensitive thermal flowmeters are not readily available.
n-Well Flow racing	Locations of transmissive fractures or fracture zones, occurrences of internal flows in wells, and relative hydraulic heads between the fractures or zones can be determined by repeated logging of electrical conductivity following an injection of a small-volume saline slug. Inexpensive and sensitive for slow flow velocities. Density effects may need to be considered.
lug Testing	Vertically averaged hydraulic conductivity value (K) for the tested well segment

permeability.

can be obtained. Variability of (K) over the study area is quantified if tests are performed in many monitoring wells. Limited to settings with low and moderate

TABLE 1 (continued)

Advantages and Limitations of Hydrogeologic Characterization Techniques Applicable to the Brunswick Formation

Technique	Information sought, advantages, and limitations
Straddle Packer Testing	Injectivity/hydraulic conductivity for packed-off intervals, and conductivity profiles with depth. Test intervals are usually larger (at least 5 feet) than individual fracture zones.
Inter-Well Techniques	
Water Level/Potentiomet- ric Surface Mapping	Distribution of heads, apparent flow direction and hydraulic gradient are usually determined from water-level measurements in monitoring wells. In multiunit aquifers, validity of such determinations depends on penetration of various units by individual wells. Apparent potentiometric anomalies can provide valuable information on the aquifer system.
Pumping Tests, Pulse Interference Tests	Typical objectives of these tests include determination of the degree of hydraulic connection between monitoring wells and aquifer/aquitard zones they penetrate, determination of apparent hydraulic parameters of the aquifer system or individual fracture zones, and demonstration of hydraulic control over a contaminated area.
Tracer Tests	Inter-well tracing under natural gradient is generally not feasible, but contaminants themselves can be viewed as tracers. Forced-gradient tracer tests can be performed in several configurations.

monitoring can be justified for larger projects.

Table 1 provides a survey of techniques of hydrogeologic characterization that may be used for the Brunswick Formation (and for similar settings with fracture-dominated permeability). For application in routine contamination investigations, only a few of these techniques are of interest.

Surface techniques, such as hydrogeologic mapping and test pits/trenches (Table 1), can be of considerable value in preliminary investigations. Because ground water occurrence and flow in the Brunswick are known to be strongly influenced by a homoclinal dip, lithologic variations, weathering, and hydrologic boundaries, knowledge of these characteristics at an early stage would aid in selecting locations for and placement of open intervals of monitoring wells. Air-rotary drilling is preferred as a well installation method, because it allows for observations and tentative identifications of major water-bearing zones. Downhole video surveys may offer a less expensive and often better alternative to coring.

In-well techniques, particularly those aimed at determination of intra-well fluid flow, are important tools for checking proper completion of individual monitoring wells, and for aiding in hydrogeologic characterization of the entire aquifer system. Temperature and electrical conductivity logging, flowmeter tests, and in-well flow tracing are included in this category (Table 1). These techniques are described by Keys (1989). The use of readily available electrical conductivity probes to track the movement and dilution of a small-volume saline slue injected into well makes a valuable and inexpensive

testing method for monitoring wells installed in the Brunswick Formation (Carswell 1976, Michalski 1989, Michalski and Klepp 1990). Because of interpretation problems, routine pumping test analyses (Table 1) can be inadequate or misleading without a prior understanding of placement of the open intervals of pumping and observation wells with respect to the structure of a multiunit aquifer.

Conclusions

 Ground water flow in the Brunswick Formation appears to be influenced primarily by partings along bedding and by the contrast in degree of fracturing between beds. A lingering belief that near-vertical fractures oriented parallel to the strike of beds dominate the flow is not supported by field data.

2. On a scale typical of most ground water contamination studies, the Brunswick Formation hosts a multiunit, leaky ground water system in which individual water-bearing units are relatively thin and parallel to the bedding. A large-scale anisotropic flow pattern results from inherent heterogeneity of the multiunit system. Along-strike flow direction is favored within the saturated reaches of individual water-bearing units, and vertical flow across intervening aquitards is produced by head differences in the water-bearing units.

 Weathering of shales has further complicated the system by reducing the permeability of water-bearing units within the weathered zone and by increasing storage of the zone. Strong vertical gradients can develop across the weathered zone, particularly in recharge areas. This promotes the downward flow and contaminant migration through wells open across the zone and/or leaks developed behind casing. Special attention should be given to installation and testing of monitoring wells that intersect the weathered zone near known sources of contamination.

Differences in permeability have been argued to account for the substantial head differences.

- 4. Current practice of treating the Brunswick Formation as a one-aquifer system, sometimes with vaguely defined "shallow" and "deep" zones, often leads to the development of inadvertent cross-flows in monitoring wells. Undetected cross-flow may promote the spread of contamination through the wells, seriously impair the quality of hydrogeologic data obtained, and misguide the development of remedial measures.
- 5. Initial hydrogeologic characterization of the Brunswick Formation should be aimed at identification of the major water-bearing and aquitard units making up the aquifer system at a site. Fluid-movement measurements in existing wells or pilot holes, and other in-well testing techniques are feasible tools for such characterization.
- 6. In general, open intervals in monitoring wells should not exceed about 20 feet for the water-bearing units. Installation of wells open entirely to aquitard units should be avoided. The use of small-diameter holes is recommended for monitoring wells open to the weathered zone. For larger projects, the use of a multiple-packer monitoring system may offer a viable alternative to open holes.

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Biographical Sketch

Andrew Michalski is director of hydrogeology with Whitman Companies Inc. (385 Highway 18, East Brunswick, NJ 08816). He received an M.Sc. and Ph.D. in hydrogeology and engineering geology from Mining Academy in Cracow, Poland. He is a professional geologist and a certified ground water professional. Over the 20-year course of his career, he has worked on hotwater sulphur mining, radioactive waste isolation, hydrogeologic assessments, and aquifer cleanup projects at numerous sites. He was a senior hydrogeologist with TRC Environmental Consultants and The Earth Technology Corp., and has taught at universities in Poland, Nigeria, and at Rutgers University in New Jersey.

REFERENCE NO. 26



Water Resource News

Sole Source Aquifer Petition Approved

by Gail P. Carter, Bureau of Groundter Resources | sluation On Thursday, June 23, 1988 the US Environmental Protection Agency (USEPA) formally designated the Fifteen Basin Aquifer Systems of Northwestern New Jersey as a federal Sole Source Aquifer Area. The fol-

lowing day, June 24, the USEPA designated the southern portion of the State as the New Jersey Coastal Plain Aquifer System. These designations follow three and a half years of effort by the New Jersey Geological Survey, an Element within the Division of Water Resources, to have all eligible areas of the State designated as federal sole source aquifers.

The federal sole source aquifer program is part of Section 1424(e) of the Safe Drinking Water Act (SDWA) 42 U.S.C. 300-h-3(e). The sole source designation means that the federal government has determined that the aquifer is the sole or principal source of drinking water for an area and if contaminated, would pose a significant hazard to public health. This determination is based on the evaluation of five aspects of the ground-water resource. The aquifer system must be a coherent hydrogeologic flow system, provide more than fifty percent (50%) of the drinking water used in the area, be susceptible to contamination, result in a significant hazard to the public health if contaminated, and have no readily available alternate sources of drinking water.

Once a sole source aquifer is designated, all proposed federally-assisted projects in the aquifer area must be reviewed by USEPA. Federally-assisted projects are those projects which receive federal financial assistance through a grant, contract, loan guarantee or otherwise. The purpose of the federal project review is to ensure that the projects are designed and constructed so they do not pose a significant hazard to the public health through contamination of the aquifer. Privately funded

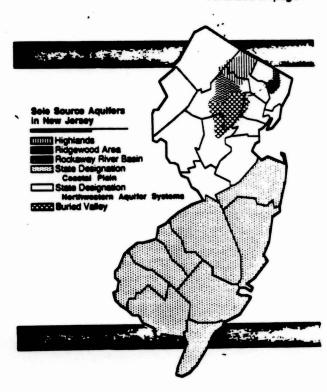
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construction projects and existing federally-assisted projects are not reviewed by the USEPA under this program.

The Fitteen Basin Aquifer System covers about 1,735 square miles and includes all of Warren County and portions of Sussex, Passaic, Morris, Middlesex, Hunterdon, Mercer and Somerset Counties. In combination these aquifer systems supply 49.3 million gallons per day of drinking water to about 493,102 people residing in 109 municipalities. This is 86% of the drinking water supplied in the region.

The Coastal Plain Aquifer System covers about 4,490 square miles and includes all of Monmouth, Burlington, Ocean, Camden, Gloucester, Atlantic, Salem, Cumberland, Cape May and portions of Mercer and Middlesex Counties. In combination, the aquifers in the Coastal Plain system supply 276.3 million gallons per day of drinking water to 2,126,171 people residing in 268 municipalities. This is

Continued on page 7



Wellhead Protection Program Planned

The Division of Water Resources is in the process of developing a wellhead protection program plan for public community water supply wells and large

groups of private wells. The program is intended to safeguard groundwater wells against sudden or unforeseen contamination from nearby potential pollution sites. The program will be a critically important one in the State's efforts to protect groundwater in developed areas.

All states are required by federal law to submit wellhead protection programs for public community wells to the Environmental Protection Agency (EPA) by June of 1989, but no federal funding has been made available for implementing State plans. The decision has been made that New Jersey will proceed with its planning and implementation regardless of federal funding availability, and will include large groups of private wells in addition to the public wells. New Jersey's program will be accomplished through adding new responsibilities to existing regulatory programs and local planning boards, rather than creating a completely new regulatory program, which appears unnecessary and would be costly.

Following are the key components of the tentative plan as developed over the summer of 1988.

The New Jersey Geological Survey will take the lead in determining interim wellhead criteria, based on rate of flow or other similar parameter, type of geologic formation, depth of well, and volume of water withdrawn. The interim wellhead areas designated will be large enough to be reasonably sure that the ultimate wellhead area, which may be determined by a special hydrogeological survey, will be included within it.

The location of the existing 1800 public community wells are not all located on maps with sufficient accuracy for the needs of the program. Water allocation permit procedures will therefore be modified to require owners of these wells to submit accurate location information. The location of groups of private wells, primarily those covered by subdivision approvals of 50 or more units (30 in critical areas), will be obtained from county health officials or planning boards. All of this information will be placed in a computerized database.

The database will also include information on potential pollution sites within the wellhead area, such as landfills, hazardous waste sites, filling stations and garages, underground storage tanks, septic fields, chemical or salt storage sites. These sources will be controlled under existing programs and through the Statewide Non-point Source Control Program,

now being developed. In addition to State lations, local planning boards will be couraged to avoid wellhead protection areas siting new facilities. Ultimately legislation may be sought to make wellhead area restrictions mandatory in local planning board responsibilities.

Following the development of the interim wellhead criteria, a proposed wellhead protection regulation will be drafted under the authority of existing legislation including the Clean Water Act, New Jersey Safe Drinking Water Act and Water Supply Management Act. An advisory group will be appointed to guide public participation efforts. A series of public meetings will be undertaken during which various alternative wellhead criteria will be aired prior to formal proposal, which should occur in the fall of 1989.

If you or your organization would like to be on the mailing list for developments relating to the wellhead protection program, please write to: William Whipple, Assistant Director, Division of Water Resources, Planning and Standards Element, CN-029, Trenton, NJ 08625.

Sole Source Aquifer Petition

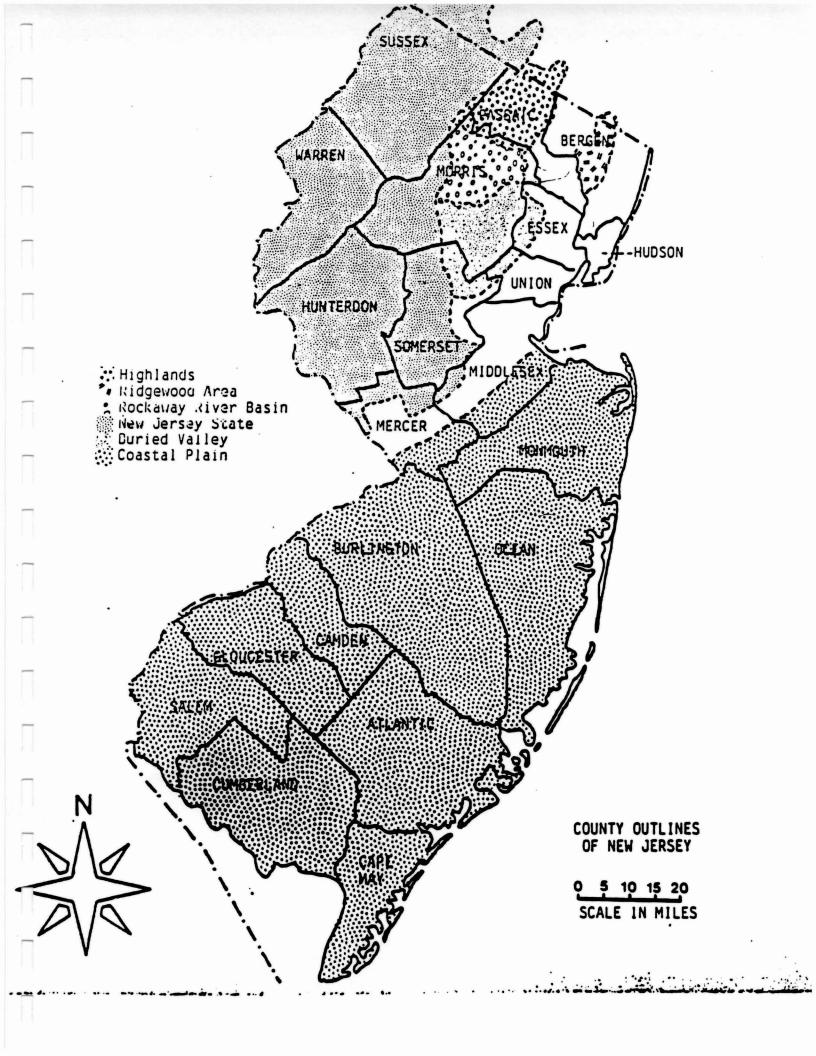
75% of the drinking water supplied in the region.

In addition to the two areas designated this June, four other areas of the State had previously been designated Sole Source Aquifers by the USEPA. These other Sole Source Aquifer areas are the Buried Valley Aquifer in Southeastern Morris and Western Essex Counties (1980), the Ridgewood Brunswick Shale and Sandstone Aquifer (1984), the Upper Rockaway River Basin Unconsolidated Quaternary Aquifer (1984) and the Highlands Aquifer System (1987). In combination, approximately three-quarters of New Jersey is now designated as a federal Sole Source Aquifer area.

Achieving these designations will ensure consistent federal ground-water protection efforts for all designated areas of the State. These designations provide an opportunity to increase community awareness of the importance and vulnerability of its ground-water resources. The designated areas also become eligible for special Critical Aquifer Protection Area Grants from the USEPA.

Additional information on the designation can be obtained from John Malleck, Chief, Office of Ground-Water Management, Water Management Division, EPA Region II, 26 Federal Plaza, NY, NY 10278.

"The program is intended to safeguard groundwater wells against... contamination"



New Jersey Coastal Plain

- Petition Date: December 4, 1978
- Petitioners: Environmental Defense Fund and the New Jersey Chapter of the Sierra Club (national and state environmental organizations)
- Location: all of Monmouth, Ocean, Burlington, Camden, Gloucester, Atlantic, Salem, Cumberland, and Cape May Counties, and part of Middlesex and Mercer Counties.
- Aquifer Description: thick sequence of unconsolidated sedimentary formations
- Depth to Ground Water: generally less than 25 feet
- Approximate Population: 2,300,000
- Drinking Water from Ground Water: approximately 75%
- Population Served by PWS / Domestic Wells: 80% / 20%
- Quality: generally of drinking water quality after minor treatment (filtration, aeration, pH adjustment, softening and/or iron and phosphate removal)
- Vulnerability: high
- Designation Date: Designation pending. NJDEP supports designation and requests that it be designated at the same time as the New Jersey Statewide SSA petition.

designated as of June 10, 1988

NEW JERSEY SOLE SOURCE AOUIFERS

Buried Valley Aquifer System

- Petition Date: January 15, 1979
- Petitioner: City of East Orange and Passaic River Coalition (regional environmental organization)
- Location: approximately 320 square miles in southeastern Morris and western Essex Counties
- Aquifer Description: thick glacial deposits filling bedrock valleys and fractured bedrock
- Depth to Ground Water: generally less than 25 feet
- Approximate Population: 600,000
- Drinking Water from Ground Water: 95%
- Population Served by PWS / Domestic Wells: 87% / 13%
- Quality: generally of drinking water quality after disinfection
- Vulnerability: high
- Designation Date: May 8, 1980

Brunswick Shale and Sandstone Aquifer

- Petition Date: July 4, 1979
- Petitioner: Committee to Keep Our Water Pure (local environmental organization)
- Location: approximately 18 square miles in Bergen County
- Aquifer Description: fractured bedrock
- Depth to Ground Water: generally less than 25 feet
- Approximate Population: 62,800
- Drinking Water from Ground Water: 100%
- Population Served by PWS / Domestic Wells: 100% / 0%
- Quality: generally of drinking water quality after minor treatment (filtration, aeration, pH adjustment, softening and/or iron and phosphate removal)
- Vulnerability: high
- Designation Date: January 24, 1984

Rockaway River Area

- Petition Date: November 30, 1979
- Petitioner: Upper Rockaway River Watershed Association (local environmental organization)
- Location: thirteen municipalities in Morris County
- Aquifer Description: thick glacial deposits filling bedrock valleys and fractured bedrock
- Depth to Ground Water: generally less than 25 feet
- Approximate Population: 90,000
- Drinking Water from Ground Water: approximately 67%
- Population Served by PWS / Domestic Wells: 75% / 25%
- Quality: generally of drinking water quality after minor treatment (filtration, aeration, pH adjustment, softening and/or iron and phosphate removal)
- Vulnerability: high

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- Designation Date: January 24, 1984

Highlands Aquifer System

- Petition Date: March 14, 1985
- Petitioner: Township of West Milford and Passaic River Coalition (regional environmental organization)
- Location: approximately 290 square miles in Passaic,
 Bergen, Morris, and Sussex Counties
- Aquifer Description: thin glacial deposits and fractured bedrock
- Depth to Ground Water: generally less than 25 feet
- Approximate Population: 89,000
- Drinking Water from Ground Water: 81%
- Population Served by PWS / Domestic Wells: 60% / 40%
- Quality: generally of drinking water quality after disinfection
- Vulnerability: high
- Designation Date: October 5, 1987

New Jersey Statewide

- Petition Date: November 18, 1985
- Petitioner: New Jersey Department of Environmental Protection.
- Location: fiftean. drainage basins, comprised of all of Warren and Hunterdon Counties, and portions of Sussex, Passaic, Morris, Somerset, Mercer and Middlesex Counties, NJ, and Orange County, NY.
- Aquifer Description: thin glacial deposits and fractured bedrock
- Depth to Ground Water: generally less than 25 feet
- Approximate Population: 493,102
- Drinking Water from Ground Water: approximately 86%
- Population Served by PWS / Domestic Wells: 46% / 54%
- Quality: generally of drinking water quality after disinfection
- Vulnerability: high
- Designation Date: Under review in Region II. Public hearings scheduled for March 23, 1988 and March 24, 1988.

designated as of June 10, 1988

REFERENCE NO. 27

OCCURRENCE AND MOVEMENT OF GROUND WATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY

By JOHN VECCHIOLI, LOUIS D. CARSWELL, and HAIG F. KASABACH 1, Trenton, N.J.

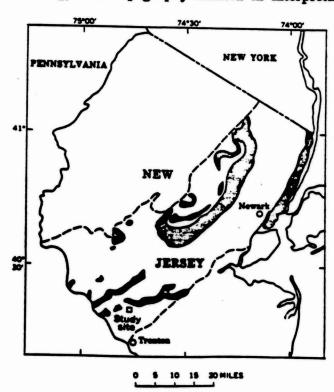
Work done in cooperation with the New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply and Bureau of Geology and Topography

Abstract.—Measurements of yield made during the drilling of 18 wells in the Brunswick Shale of Late Triassic age near Trenton, N.J., indicate that ground water occurs mainly in discrete sones controlled by bedding. Productivity of a well may be dependent on only one or on several sones; however, no relation was apparent between yield and the number of sones penetrated. Movement of water under pumping conditions, and presumably under natural conditions, is preferentially along strike, as indicated by drawdown observations made during several pumping tests. Wells situated along strike and thus tapping common producing sones had a greater drawdown than wells equidistant in transverse directions. Knowledge of a preferential direction of water movement in the Brunswick Shale is invaluable when locating a well with respect to a potential source of pollution or in attempting to minimise well interference.

The literature is replete with detailed accounts of the occurrence and movement of ground water in granular aquifers, but comparatively little has been presented regarding ground water in fractured-rock aquifers. Opportunity was afforded to conduct research into ground-water occurrence and movement in the Brunswick Shale—a principal aquifer throughout a large part of central and northeastern New Jersey—on a 20-acre site located 10 miles north of Trenton, N.J. (fig. 1). The site is on property dedicated for research by the Stony Brook-Millstone Watersheds Association and known as the New Land Research Reserve.

Acknowledgments.—Thanks are due the Stony Brook-Millstone Watersheds Association for allowing use of their land for this research, and in particular

to Mr. Richard S. Thorsell, Resource Director of the Association, for coordinating the activities, and to Mr. L. H. Terpening, member of the Association, for personally bearing part of the test-drilling costs. Mr. Joseph W. Miller, Jr., Geologist, New Jersey Bureau of Geology and Topography assisted in interpreting



Fasure 1.—Sketch map of northern New Jersey, showing location of study site and extent of outcrop area of Newark Group (dashed lines). Stippled areas are igneous rocks.

¹ Geologist, New Jersey Department of Concervation and Remember Development, Division of Water Policy and Supply.

the geology of the site. The Dinunzi Well Drilling Co., Inc., cooperated fully in making special measurements while they were drilling the test wells.

GEOLOGY AND AQUIFER CHARACTERISTICS

The Brunswick Shale is the youngest, thickest, and most extensive unit of the Newark Group of Late Triassic age. The Newark Group crops out across northern New Jersey in a broad northeast-trending belt (fig. 1) that is part of the Triassic structural trough extending from southern New York through New Jersey, into Pennsylvan's and thence southward into Maryland and Virginia. At the site investigated the Brunswick Shale consists of alternating beds of red mudstone, shale, and siltstone. These beds are folded into a northwesterly plunging syncline. The site is characterized by gently rolling topography with more resistant beds forming minor ridges having a maximum relief of about 10 feet. The beds are broken by a dominant near-vertical joint set whose strike approximately parallels the strike of the beds. Secondary near-vertical joints are roughly perpendicular to the primary set, and random joints of minor importance are common. The intersecting fractures that have resulted from the jointing provide the principal means of storage and movement of ground water in the Brunswick.

Earlier work (Vecchioli, 1967) indicated in a general way that under pumping conditions the Brunswick Shale exhibits directional rather than isotropic hydraulic behavior, and that maximum and minimum directions of anisotropy are related to the structural orientation of the formation. For this study, test wells were located so as to provide more detailed information on the aquifer's anisotropy.

LOCATION OF TEST WELLS

The arrangement of the 18 wells in relation to geologic structure is shown in figure 2. Well 1, which was selected to be the pumping well, and 9 of the observation wells were drilled to a depth of about 150 feet on the west limb of the northwesterly plunging syncline where the beds strike east-west and dip an average of about 25° N. Eight of the observation wells were located radially from well 1 at a distance of 800 feet in directions parallel to the strike and dip of the beds and at an angle of 45° to the strike. Well 6 was drilled 100 feet downdip from well 1 and to a depth of 200 feet so as to fully penetrate all the beds present in well 1. Well 10 was drilled 600 feet west of and along strike from well 1 in an attempt to determine the shape of the drawdown cone in the strike direction.

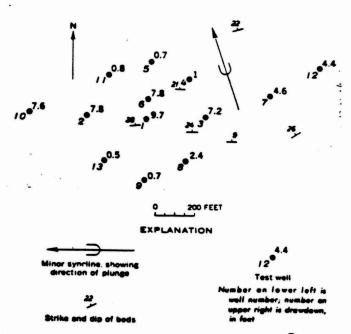


FIGURE 2:—Map showing geologic structure of the New Land Research Reserve site, location of test wells, and drawdown distribution at end of 8-hour pumping test of well 1 at 16 gpm.

Observation wells—7 and 12—were drilled to a depth of 150 feet on the east limb of the syncline where the beds strike east-northeast and dip about 25° N. These wells were drilled at a distance of 675 and 975 feet, respectively, from well 1 as measured along strike and were intended to fully penetrate the same sequence of beds as well 1 and the other wells alined along the strike with well 1. However, upon completion it was determined that these wells do not fully penetrate all the beds and producing zones present in well 1 as a result of a slight thickening of the sequence on the east limb of the syncline as well as the positioning of the wells slightly downdip from their designed locations because of terrain conditions.

DISTRIBUTION OF PRODUCING ZONES

All wells were drilled by the air-rotary method, a drilling method in which compressed air is forced out the end of a rotating bit and up the annular space between the drill column and the wall of the borehole. The "cuttings" and also the ground water entering the borehole are carried to the surface by the circulating air. This drilling method facilitates the identification of water-bearing sones as the well is deepened because the amount of water blown from the borehole can be measured and a log of discharge versus depth can thus be obtained. Discharge measurements were made at 10-foot intervals in all the wells during drilling, once the discharge of water started. In addition, the presence of wet chips or mud was

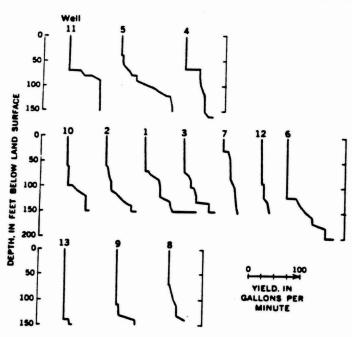


FIGURE 8.—Logs of well discharge at time of drilling.

recorded from zones above those zones that yield measurable quantities of water. Discharge logs are shown in figure 8.

The discharge logs of the wells are arranged in three "strike" groups from north to south across the site. Although the alinement of the wells with strike is not perfect, and minor adjustments for differences in landsurface elevation have not been made, the similarity or the logs within each group is readily apparent. The "stepped" character of the curves is also obvious, and indicates that the water is not evenly distributed throughout the formation, but that it occurs in discrete zones. Important producing zones are reflected on the logs by a sharp shift of the curve toward the right, which indicates that there was a marked increase in the water being discharged at this point in the drilling. The increase in yield of some of the wells at the finished depth reflects final development of the well and not necessarily a new producing horizon. It is not clear why the yield increases gradually with depth in parts of some wells (well 5, for example). It may be that the water-bearing sone in these places is thick and that the water is more evenly distributed throughout the interval, or that the gradually increasing yield may be a result of the more complete development of a discrete zone. The latter interpretation is favored here on the basis of supporting data obtained from borehole-velocity measurements in several wells, and on the fact that major caving started in well 5 just below a depth of 80 feet and that this zone

continued to cave throughout the deepening of thole.

Producing zones are restricted to favorable beds the are areally extensive along strike, as demonstrated the similarity of the discharge logs and the pumpir test data discussed below. Along dip, however, the coff the formation carries the water-producing zone excessive depths within short distances. Figure 4 shows a section through the well field from south to not through wells 9, 1, 6, and 5, with wells 8 and 4 projected into the line of section. Some zones were present in only one borehole, whereas others were present two or more boreholes alined in the dip direction.

Lithologically, the producing zones are similar the nonproducing zones insofar as could be reveal by field examination of the drill cuttings. However, these zones appear to be distinctively fractured, as greater percentage of the drill cuttings from the producing zones had chip faces that were smooth as planar, which suggests better defined jointing. In addition, many of the planar surfaces on these chi showed signs of having been altered by circulating ground water.

Although the productivity of a well may be from some zone or from several zones, no relation was apparent between the productivity of the wells and the number of zones penetrated by them.

PUMPING TESTS

An 8-hour pumping test at a constant rate of gallons per minute was conducted on well 1, the ce trally located well, and water-level declines were mes ured periodically in all the wells. The resulting tim drawdown curves fall into two general groups, with exception of those from wells 7, 8, and 12. Or group consists of curves from wells on the west lin of the syncline alined along strike with well 1. The

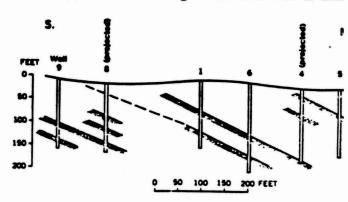


FIGURE 4.—Section showing extent of producing somes in the dip direction as determined from the wells. Producing somes shown by shading.

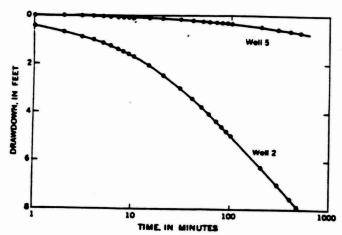


Figure 5.—Drawdown curves of wells 2 and 5 during pumping of well 1 at 16 gpm.

wells tap two common producing zones. Included in this group is the curve from well 6, which, although being downdip, was drilled deep enough to tap the same producing zones tapped by well 1. The other group includes the curves from wells alined in directions other than along strike. These wells do not tap the producing zones tapped in well 1. The drawdown trends of each group are shown in figure 5, where the curve for well 2 is typical of wells belonging to the first group, which tap the two major producing zones of well 1, whereas the curve for well 5 typifies those of the other group.

Figure 2 shows the drawdown distribution at the end of the 8-hour test. The drawdown in the wells alined parallel to strike is many times greater than in the wells alined in other directions—as much as 10 times more for those wells lying within 300 feet of well 1. The anomalous drawdown of 2.4 feet in well 8 probably results from its having penetrated the lower producing zone of well 1 (fig. 4). Although there was no measurable yield from this zone during the drilling of well 8, mud wadding on the bit when drilling through this interval suggests that the sone contains at least small amounts of water. The drawdown in wells 7 and 12 is somewhat less than that in the other wells of the strike group as a result of these wells having penetrated only the upper of the two major producing zones of well 1.

Shorter pumping tests of 2- to 8-hour duration have been run on most of the other wells. In these tests, the lowering of water levels in surrounding wells has been greatest in the direction of strike and much less in other directions, substantiating the hypothesis that the wells penetrate common producing zones that are laterally extensive along strike.

DISCUSSION

In general the literature contains a paucity of detailed pumping-test data for the Brunswick Shale. However, numerous pumping tests of wells throughout the outcrop area of the Brunswick Shale in New Jersey where drawdown observations have been made in more than one direction indicate that the aquifer has anisotropic hydraulic properties everywhere. The degree of anisotropy varies from place to place. In some areas it is considerably less than that shown here; in fact, it may even approach isotropy. Where mildly anisotropic conditions exist, one could conclude that discrete producing zones do not occur, but that the formation is thoroughly dissected by interconnecting fractures resulting in hydraulic continuity in all directions. Nonetheless, drawdown is always greatest along strike.

Practical implications of the hydraulic behavior of the Brunswick aquifer are as follows: If the water is able to move more freely in the direction of strike than in other directions, then the facility for the spread of a contaminant would be greatest along strike. Such a condition has been observed in Newark, N.J., where elongated tongues of salt water have encroached in directions parallel to strike (Herpers and Barksdale, 1951, p. 48). In addition, it is evident that well interference can be minimized by alining wells in directions other than parallel to strike. Moreover, knowledge of the anisotropic hydraulic behavior could also have application in planning housing developments that have private wells and waste disposal, so as to minimize the possibility of contaminating the ground-water supply to individual houses.

REFERENCES

Herpere, Henry, and Barhedale, H. C., 1961, Preliminary report on the geology and ground-water supply of the Newark, New Jersey, area: New Jersey Dept. Conserv. and Econ. Devel., Div. of Water Policy and Supply Spec. Rept. 10, 83 p.

Vecchioli, John, 1987, Directional hydraulic behavior of a fractured-chale squifer in New Jersey, in International symposium on hydrology of fractured rocks, Tugoslavia 1965, Proc., v. 1: Internat. Assoc. Sci. Hydrology Pub. 78, p. 818–826.

REFERENCE NO. 28

Minione NH Status : 10 - enter Form Approved. OMB No. 2050-0028. Expires 9-30-88. GSA No. 0246-EPA-OT Please print or type with ELITE type (12 characters per inch) in the unshaded areas only Please refer to the Instructions for Filing Notification before completing this form. The information requested here is required by law (Section 3010 of the Resource Conservation and Recovery Act). United States Environmental Protection Agency Washington, DC 20460 Notification of Hazardous Waste Activity For Official Use Only AL PROPERTY OF THE PERSON OF T Ċ **Date Received** day) mo. Installation's EPA ID Number Approved . Name of Installations Installation Mailing Address Street or P.O. Box 1 4 **ZIP Code** City or Town State Street or Route Number to the time. *State Name and Hitle (last dirst and job title) V3Ownership Ar Name of Installation's Legal Owner - B. Type of Ownership (enter code) VI Type of Regulated Waste Activity (Mark X' in the appropriate boxes. Refer to instructions.) B. Used Oil Fuel Activities ☐ 6. Off-Specification Used Oil Fuel Ta Generator 1b. Less than 1,000 kg/mo. | Content of the cont (enter 'X' and mark appropriate boxes below) a. Generator Marketing to Burner ■ b. Other Marketer C. Burner 7. Specification Used Oil Fuel Marketer (or On site Burner) Who First Claims the Oil Meets the Specification VII. Waste Fuel Burning: Type of Combustion Device (enter 'X' in all appropriate boxes to indicate type of combustion device(s) in which hazardous waste fuel of bit-specification used oil fuel is burned. See instructions for definitions of combustion devices.)

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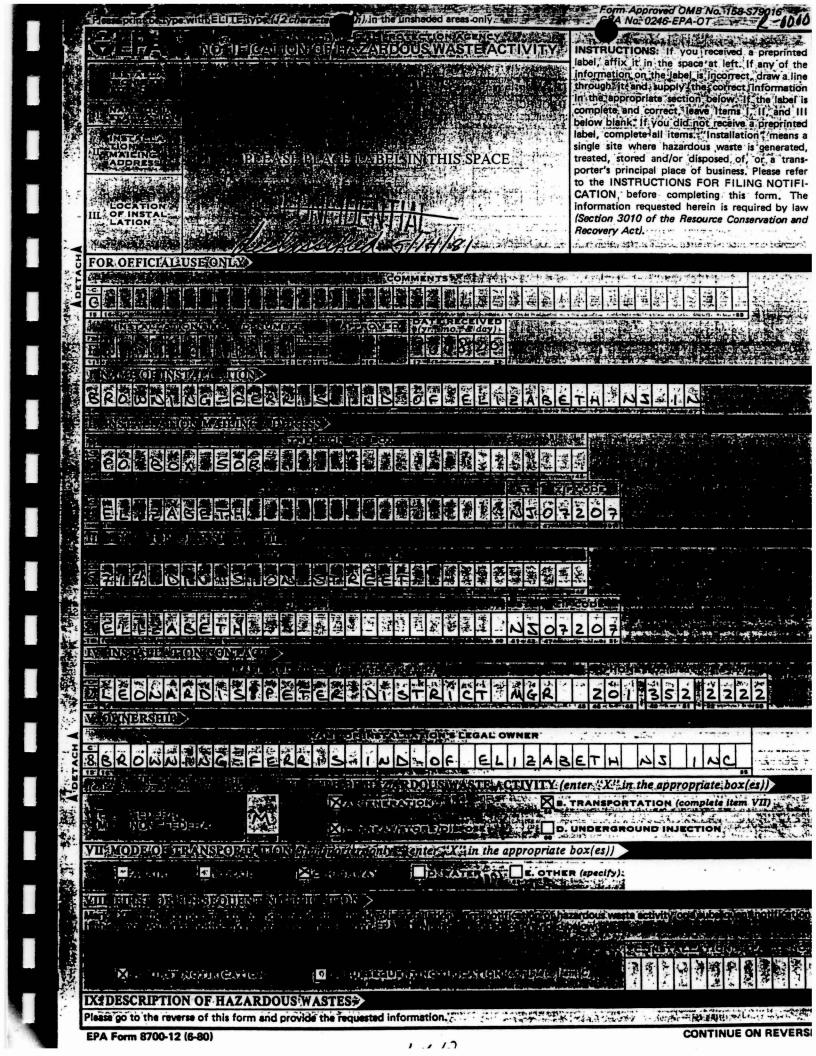
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this is not your first n	notification, enter your Installation's EPA I.D. Number in the space provided below.	
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CONFIDENTIAL

- FOR OFFICIAL USE ONLY
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X. DESCRIPTION OF HAZARDOUS WASTES (continued from front)
A. HAZARDOUS WASTES FROM NON—SPECIFIC SOURCES. Enter the four—digit number from 40 CFR Part 261.31 for each listed hazardous waste from non—specific sources your installation handles. Use additional sheets if necessary.
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B. HAZARDOUS WASTES FROM SPECIFIC SOURCES. Enter the four—digit number from 40 CFR Part 261.32 for each listed hazardous waste from specific industrial sources your installation handles. Use additional sheets if necessary.
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E. CHARACTERISTICS OF NON-LISTED HAZARDOUS WASTES. Mark "X" in the boxes corresponding to the characteristics of non-listed hazardous wastes your installation handles. (See 40 CFR Parts 261.21 - 261.24.)
SIGNATURE NAME & OFFICIAL TITLE (type or print) DATE SIGNED

EPA Form 8700-12 (6-80) REVERSE

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SEPA	NOTIFICATION HAZARDOUS WASTE ACTIVITY	RUCTIONS: If you received a preprinted label, affix it in the space at left, if any of the
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CDM Federal Programs Corporation

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RECORD OF COMMUNICATION

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement 927 North Main Street (Bldg. D1) Pleasantville, New Jersey 08232

> Tel: 609-646-9310 FAX: 609-646-0352

Rocd 7/27/92

July 22, 1992

Ms. Patricia Tom CDM Federal Programs Corporation 111 Fulton Street, Suite 710 New York, New York 10038

Dear Ms. Tom:

This letter responds to your July 8, 1992, request to the U.S. Fish and Wildlife Service (Service) for information on the presence of federally listed and proposed endangered and threatened species, and sensitive environments at a Resource Conservation and Recovery Act investigation site located at 714 Division Street, Elizabeth, Hudson County, New Jersey.

This response is provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) to ensure the protection of endangered and threatened species and does not address all Service concerns for fish and wildlife resources. These comments do not preclude separate review and comments by the Service as afforded by the Fish and Wildlife Coordination Act (48 Stat. 401, 16 U.S.C. 661 et seq.), if any permits are required from the U.S. Army Corps of Engineers pursuant to the Clean Water Act of 1977 (33 U.S.C. 1344 et seq.), nor do they preclude comments on any forthcoming environmental documents pursuant to the National Environmental Policy Act of 1969 as amended (83 Stat. 852; 42 U.S.C. 4321 et seq.).

The Service has reviewed available information to determine the presence of any environmentally sensitive areas in the vicinity of the project. We are not aware of any sensitive environments of federal concern within the proposed project area.

Enclosed is a summary of the federally listed and candidate species in New Jersey for your information. A review of our files indicates that except for an occasional transient bald eagle (Haliaeetus leucocephalus) or peregrine falcon (Falco peregrinus), no other federally listed or proposed threatened or endangered flora or fauna are known to occur within the vicinity of the project area. Therefore, no further consultation pursuant to Section 7 of the Endangered Species Act is required by the Service. If additional information on listed and proposed species becomes available or if project plans change, this determination may be reconsidered.

Candidate species are species under consideration by the Service for possible inclusion on the List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the Service encourages federal agencies and other planners to consider candidate species in the project planning process. The New Jersey Natural Heritage Program provides the most up-to-date data source for candidate species in the State, as well as maintaining information on State listed species, and may be contacted at the following address:

Mr. Thomas Breden
Natural Heritage Program
Division of Parks and Forestry
CN 404
Trenton, New Jersey 08625
(609/984-0097)

Should the Natural Heritage Program data search reveal the presence of any candidate species on the site, the Service must be contacted to ensure that these species are not adversely affected by project activities.

Further information on State listed wildlife species may be obtained from the following office:

Ms. JoAnn Frier-Murza Endangered and Nongame Species Program Division of Fish, Game and Wildlife CN 400 Trenton, New Jersey 08625 (609/292-9101)

Information contained in this letter and additional information obtained from the aforementioned sources represents the public interest for fish and wildlife resources and should warrant full consideration in the project planning process. The Service requests that no part of this letter be taken out of context and if reproduced, the letter should appear in its entirety.

We appreciate your cooperation in this matter. Please contact Dana Peters of my staff if you have any questions or require further assistance regarding threatened or endangered species.

Sincerely,

lifford G. Day

Supervisor

Enclosures

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN NEW JERSEY

An ENDANGERED SPECIES is any species that is in danger of extinction throughout all or a significant portion of its range.

A THREATENED SPECIES is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FISHES E Sturgeon, shortnose* Acipenser brevirostrum REPTILES E Turtle, Atl. Ridley* Lepidochelys kempii Chelonia mydas T Turtle, green* E Turtle, hawksbill* Eretmochelys imbricata Turtle, leatherback* Dermochelys coriacea E Turtle, loggerhead* T Caretta caretta BIRDS Eagle, bald Haliaeetus leucocephalus E Falcon, Am. peregrine Falco peregrinus anatum E Falco peregrinus tundrius T Falcon, Arctic peregrine Plover, piping Charadrius melodus T Tern, roseate Sterna dougallii dougallii E **MAMMALS** Bat, Indiana E+ Myotis sodalis E+ Cougar, eastern Felis concolor couguar Whale, blue* Balaenoptera musculus E E Whale, finback* Balaenoptera physalus E Whale, humpback* Megaptera novaeangliae E Whale, right* Balaena glacialis E Whale, sei* Balaenoptera borealis E Whale, sperm* Physeter catodon

INVERTEBRATES

Dwarf wedge mussel Beetle, northeastern beach tiger Butterfly, Mitchell satyr American burying beetle	Alasmidonta heterodon Cicindela dorsalis dorsalis Neonympha m. mitchellii Nicrophorus americanus	E+ T+ E+ E+
	PLANTS	
Pogonia, small whorled Swamp pink Orchid, eastern prairie fringed Knieskern's beaked rush American chaffseed Joint-vetch, sensitive	Isotria medeoloides Helonias bullata Platanthera leucophaea Rhynchospora knieskernii Schwalbea americana Aeschynomene virginica	E T T+ T PE PT

STATUS:

E: endangered species
T: threatened species
+: presumed extirpated
PE: proposed endangered
PT: proposed threatened

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

Note: for a complete listing of Endangered and Threatened Wildlife and Plants refer to 50 CFR 17.11 and 17.12, July 15, 1991)

CANDIDATE SPECIES IN NEW JERSEY

CANDIDATE SPECIES in categories 1 and 2 are species that appear to warrant consideration for addition to the List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the Service encourages federal agencies and other planners to give consideration to these species in the environmental planning process.

VER	RTEBRATES	Category
Turtle, bog Terrapin, northern diamondback Snake, northern pine Duck, harlequin Rail, Black Shrike, migrant loggerhead Warbler, cerulean Bat, eastern small-footed Rabbit, New England cottontail Shrew, long-tailed Shrew, Tuckahoe masked Woodrat, eastern	Clemmys muhlenbergii Malaclemys terrapin terrapin Pituophis melanoleucus melanoleucus Histrionicus histrionicus Laterallus jamaicensis Lanius ludovicianus migrans Dendroica cerulea Myotis subulatus leibii Sylvilagus transitionalis Sorex dispar Sorex cinereus nigriculus Neotoma floridana magister	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
INV	ERTEBRATES	
Beetle, cobblestone tiger Butterfly, regal fritillary Butterfly, tawny crescent Dragonfly, banded bog skimmer Dragonfly, extra-striped snaketail Moth, Albarufan dagger Moth, Bucholz' dart Moth, Daecke's pyralid Moth, Hebard's noctuid Moth, Lemmer's pinnion Moth, precious underwing Moth, Carter's noctuid Moth, annointed sallow noctuid Skipper, Eastern beardgrass Skipper, grizzled Mussel, brook floater Mussel, green floater Mussel, yellow lamp	Cicindela marginipennis Speyeria idalia Phyciodes batesi Williamsonia lintneri Ophiogomphus anomalus Acronicta albarufa Agrotis bucholzi Crambus daeckeellus Erythroecia hebardi Lithophane lemmeri Catocala pretiosa Spartiniphaga carterae Pyreferra ceromatica Atrytone arogos arogos Pyrgus wyandot Alasmidonta varicosa Lasmigona subviridis Lampsilis cariosa	2 2* 2 2 2 2 2 3C 2 2 2* 2 2* 2 2* 2 2*

PLANTS

Blazingstar	<u>Liatris</u> <u>borealis</u>	2
Bog asphodel	Narthecium americanum	1
Boneset, Pine Barrens	Eupatorium resinosum	2
Bulrush, Long's	Scirpus longii	2
Butternut	Juglans cinerea	2
Chaffseed	Schwalbea americana	PE
Joint-vetch, sensitive	Aeschynomene virginica	PT
Lobelia, Boykin's	Lobelia boykinii	2
Meadowbeauty, awned	Rhexia aristosa	2
Micranthemum, Nuttall's	Micranthemum micranthemoides	1*
Morning-glory, Pickering's	Stylisma pickeringii var. pickeringii	2
Panic grass, Hirst's	Panicum hirstii	2
Pigweed, sea-beach	Amaranthus pumilus	2
Pondweed	Potamogeton confervoides	2
Rush, New Jersey	Juncus caesariensis	2
Sedge, variable	Carex polymorpha	2
Spring beauty	<u>Claytonia</u> sp.	2
Spurge, Darlington's	Euphorbia purpurea	2
Tick-trefoil, ground-spreading	Desmodium humifusum	2
Verbena	<u>Verbena</u> <u>riparia</u>	2?

STATUS:

- 1: Taxa for which the Service currently has substantial information to support the appropriateness of proposing to list the species as threatened or endangered. Development and publication of proposed rules on these species is anticipated.
- 2: Taxa for which information now in possession of the Service indicates that proposing to list the species as threatened or endangered is possibly appropriate, but for which conclusive data are not available to support proposed rules at this time.

3C: Taxa that have proven to be more abundant than previously believed and/or those that are not subject to any identifiable threat. If further research or changes in habitat indicate a significant decline in any of these taza, they may be reevaluated for possible inclusion in categories 1 or 2.

PE: Proposed Endangered species

PT: Proposed Threatened species

- * indicates those species for which there have been no authenticated records in New Jersey since 1963; some of these are possibly extinct, but further research is needed to determine their status with any confidence.
- ? indicates those species for which occurrence in New Jersey is questionable.

Note: for complete listings of taxa under review, refer to <u>Federal Register</u> Vol. 56, No. 225, Nov. 21, 1991 (Animal) and Vol. 55., No. 35, February 21, 1990 (Plants).

CDM Federal Programs Corporation

RECORD OF COMMUNICATION

PROJECT: EPI	DATE: 8/18/92 TIME: 11: 25 AM AM/PM RECORDED BY: Pato Tom CONTRACT NO. 7258024R947742
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TELEPHONE CONVERSATION	DATE:	19/92	
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Edward Bilazski B	In takes GANIZATION/DEPARTMENT	rect CityHall	
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RECORD OF COMMUNICATION

PROJECT: CONTRACT IS SUBJECT: CONTRACT IS SUBJECT: BF /	7at Tom	
Participants Part Tom CDM/FPC Pove Laposta EPA/WMD(C		
SUMMARY: BFI located in Eliza in an area vith any de Source agnifer. it is into us and with a sole source agnifer.	beth, UT is a signated signated signated signated signated signated signates	not ole of an
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TELEPHONE CONVERSATION DATE: 8/19/92
☐ INCOMING ☐ OUTGOING TIME: 9:50 AMPM
□ MEETING RECORDED BY: Pat Tom
PROJECT: EPI - BFI CONTRACT NO. 725858 R9422 SUBJECT: Surface warler In takes PARTICIPANTS ORGANIZATION/DEPARTMENT TELEPHONE/EXT. Edward Bilazsh Billing + Collection Supervisor (908) 820-4123 Pat Tom OPE / Labeth CityHall Pat Tom OPM / Federal (212) 393-9634
SUMMARY: The City of Elizabeth obtains all their water from Elizabeth Town Water Company which comes from a source outside Elizabeth and the City of Newark whosefloorace is from a reservoir. No one utilizes the Elizabeth River or anyother river in Elizabeth to serve a copulation or ivrigate any food Crops. There are is a well in the western pant of Elizabeth on Wyoming Are wear Formace Raymond Torrance. He didn't know more Han the fact that a residence utilizer it. It may be used currently for drinking on it interpretation.
DISTRIBUTION: PARTICIPANTS INFORMATION ACTION OTHER: